50

TM 11-2444

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

Ch 1 & 2
see ch 3

TM 11/2444—Wind Direction and Speed Recorders RO-2/GMQ and RO-2A/GMQ—1955

WIND DIRECTION AND SPEED RECORDERS RO-2/GMQ AND RO-2A/GMQ

THIS COPY MUST BE RETURNED
TO DEPOT LIBRARY

DEPARTMENT OF THE ARMY • JULY 1955

TECHNICAL MANUAL
No. 11-2444

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., 12 July 1955

WIND DIRECTION AND SPEED RECORDERS RO–2/GMQ AND RO–2A/GMQ

		Paragraph	Page
CHAPTER 1.	INTRODUCTION		
Section I.	General	1, 2	3
II.	Description and data	3–9	3
CHAPTER 2.	INSTALLATION	10–14	10
3.	OPERATION	15–21	18
4.	ORGANIZATIONAL MAINTENANCE		
ction I.	Preventive maintenance services	22–25	29
II.	Lubrication and weatherproofing	26–28	32
III.	Troubleshooting at organizational maintenance level	29–34	35
CHAPTER 5.	THEORY OF OPERATION		
Section I.	Introduction	35, 36	43
II.	Wind direction	37–40	44
III.	Wind speed	41, 42	47
IV.	Chart drive mechanism	43, 44	48
V.	Electrical power	45, 46	48
CHAPTER 6.	FIELD MAINTENANCE		
Section I.	Checking, stripping, and cleaning	47–51	50
II.	Troubleshooting at field maintenance level	52–54	55
III.	Repairs	55–74	58
IV.	Alinement procedures	75, 76	83
CHAPTER 7.	SHIPMENT AND STORAGE AND DEMOLITION TO PREVENT ENEMY USE		
Section I.	Shipment and storage	77, 78	85
II.	Demolition of materiel to prevent enemy use	79, 80	86
INDEX			90

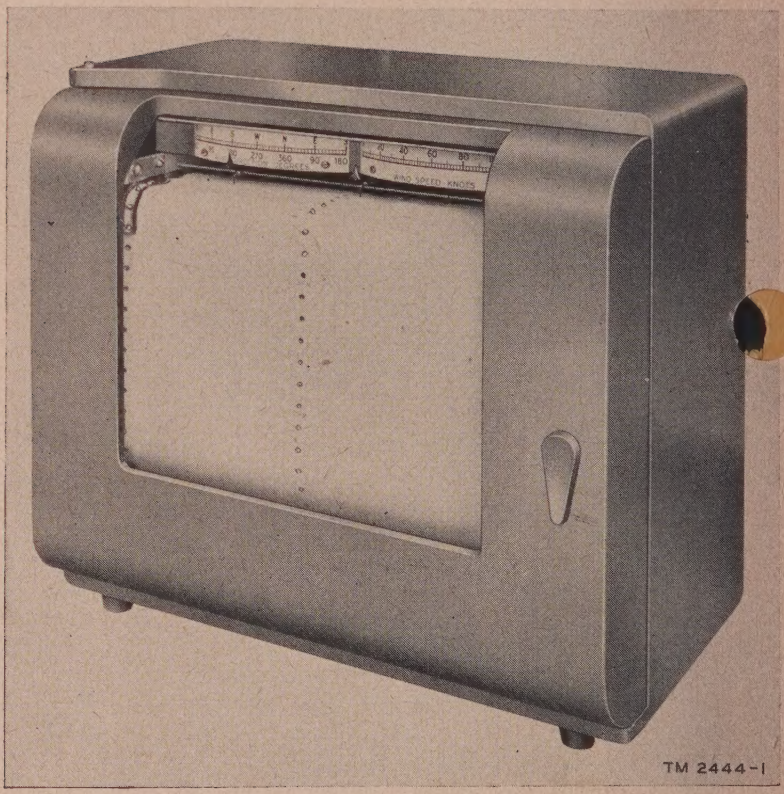


Figure 1. Wind Direction and Speed Recorder RO–2/GMQ or RO–2A/GMQ.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains instructions for the installation, operation, maintenance, and repair of Wind Direction and Speed Recorders RO–2/GMQ and RO–2A/GMQ. A chapter on theory of operation is also included.

b. Forward comments on this publication direct to Commanding [illegible]r, The Signal Corps Publications Agency, Fort Monmouth, N. J., [illegible]N: Standards Division.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army equipment.

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5 (Army); Navy Shipping Guide, Article 1850–4 (Navy); and AFR 71–4 (Air Force).

b. DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700–45–5.

c. DD Form 535, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700–45–5 and AF TO 00–35D–54.

d. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. General
(fig. 1)

a. Purpose and Use. Wind Direction and Speed Recorders RO–2/-GMQ and RO–2A/GMQ are two-element recorders that simultaneously produce, in separate channels, inked traces of wind direction and speed [illegible]es on a continuous strip paper chart. The mechanism is housed in [illegible]t-aluminum case for mounting on either a vertical or horizontal

surface. Wind Direction and Speed Recorders RO–2/GMQ and RO–2A/GMQ are used with Wind Measuring Set AN/GMQ–11 (TM 11–2443). The AN/GMQ–11 is not supplied as part of the RO–2/GMQ but is required for operation.

b. Common Names. The following is a list of nomenclature and the common names used in their place in the manual.

Nomenclature	*Common name*
Wind Direction and Speed Recorders RO–2/GMQ and RO–2/GMQ.	Recorder.
Wind Measuring Set AN/GMQ–11	Wind measuring set.
Wind Measuring and Speed Indicator ID–373/GMQ–11	Indicator.
Wind Direction and Speed Transmitter T–420/GMQ–11	Transmitter.
Wind Direction and Speed Transmitter Support MT–1246/GMQ–11.	Support.

4. Components

The equipment consists of an 8-foot long power cable and a recorder unit that is $13\frac{15}{16}$ inches high, $10\frac{1}{16}$ inches deep, $15\frac{5}{8}$ inches wide, has a volume of $1\frac{1}{3}$ cubic feet, and weighs 44 pounds. Running spares and accessories (par. 6) are also supplied.

5. Description of Recorders

(fig. 2)

a. Recorder Unit. Each recorder unit basically consists of a wind

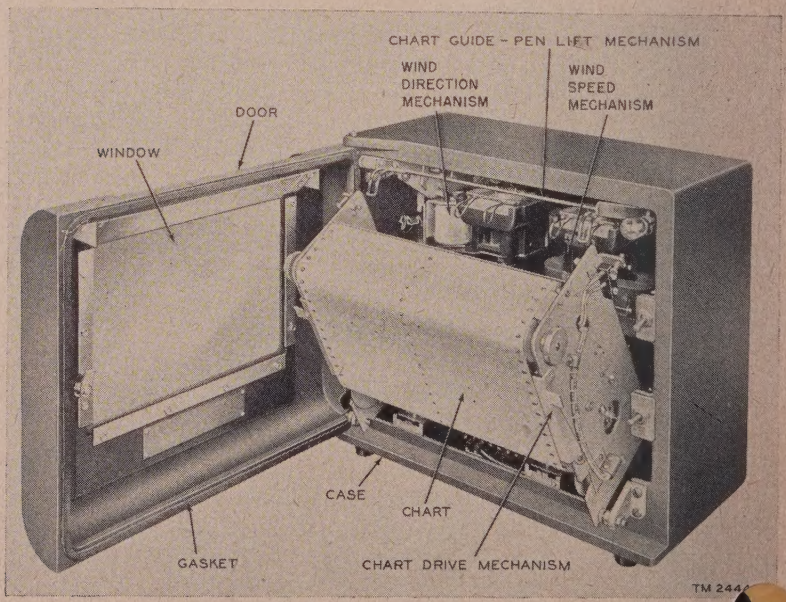


Figure 2. Recorder unit, door open, chart drive mechanism tilted.

direction mechanism, a wind speed mechanism, chart drive mechanism, chart guide-pen lift mechanism, chart, and case. A description of each is given in (1) through (6) below.

(1) *Wind direction mechanism* (fig. 2). This mechanism consists of the pen-positioning mechanism, the pen-repositioning mechanism, and the inking system.

(2) *Wind speed mechanism* (fig. 2). The major parts of this mechanism are a permanent-magnet, moving-coil voltmeter, and a removable pen.

(3) *Chart drive mechanism* (figs. 11 and 12). The chart drive mechanism is a removable, self-contained assembly. The assembly consists of a frame which holds the sprocket-type drive roll, the chart, the takeup reel, the two motors (drive and takeup), the chart movement switch, and a set of change gears.

(4) *Chart guide-pen lift mechnism* (fig. 2). This mechanism consists primarily of chart guides, pen lift bar, and direction and speed scales.

(5) *Chart* (fig. 2). The strip-type chart is divided into two channels for the recording of wind speed and wind direction. The wind speed channel is graduated every 2 knots from 0 to 120 knots and is 4.5 inches wide. The wind direction channel is graduated every 10° over a 540° range and is 4.513 inches wide. The entire chart is 93 feet long and 10¾ inches wide. Direction letters representing the cardinal compass points (NESWNES) are printed above the appropriate numerical direction values. Time lines are graduated to 10 minutes and numbered every hour.

(6) *Case* (fig. 2). The case has a hinged door with a rubber gasket which contains a plastic window large enough for viewing the indication scales, pens, and 7 inches of the record. A recess at the bottom rear of the case has connections for the power and transmitter cables (fig. 6).

b. Power Cable (fig. 6). The power cable is 8 feet long and has a two-contact connector on one end which plugs into the receptable at the rear of the case. At the other end is a connector that fits into the alternating-current (ac) power source receptacle.

6. Running Spares and Accessories

The following chart lists the running spares and accessories supplied with the equipment:

Quantity and item	Function
Running spares:	
25 chart rolls	Shows written record of wind direction and speed.
1 panel lamp	Lights recorder panel.
5 fuses (1 amp)	Safeguards the equipment.
Accessories:	
1 pen filler	Used to fill pen.
1 ink tank filler	Used to fill ink tank.
1 pt green ink	Used to inscribe permanent record.
2 pen points	On end of penholder, writing agent.

Note. The chart above is for general information only. See appropriate publications for requisitioning of spare parts.

7. Technical Characteristics

Power supply:	
RO–2/GMQ	105 to 125 v ac, 60 cycles, single phase, 80 watts.
RO–2A/GMQ	105 to 125 v ac, 50 to 65 cycles, single phase, 80 watts.
Range of recorder measurements:	
Wind direction	360°.
Wind speed	0 to 120 knots or 0 to 240 knots.
Recorder accuracy:	
Wind direction	±4° (pen follows transmitter within ±4°).
Wind speed	±1 per cent of full scale on 0 to 120 and 0 to 240 knots.
Atmospheric conditions:	
Temperature	−10° to +125°F.
Relative humidity	0 to 95 per cent.
Elevation	0 to 10,000 ft.
Running time	15 days (chart speed of 3 in. per hr) or 7½ days (chart speed of 6 in. per hr).
Signal input:	
Wind direction	Input from remote synchro (transmitter) representing a wind direction.
Wind speed	0 to 14.6 ±.01 v, dc represents 0 to 120 knots wind speed. 0 to 29.2 ±.02 v, dc represents 0 to 240 knots wind speed.

8. Packaging Data
(figs. 3 and 4)

a. The recorder, power cable, spare parts, literature, and accessories are all contained in a wooden box. The dimensions, volume, and weight of the wooden box when prepared for export or domestic shipment are listed in the chart below.

Type of shipment	Dimension (in.)			Volume (cu ft)	Weight (lb)
	Height	Depth	Width		
Export	18¾	20 9/16	24	5.3	115
Domestic	17	18¾	22	4.8	107

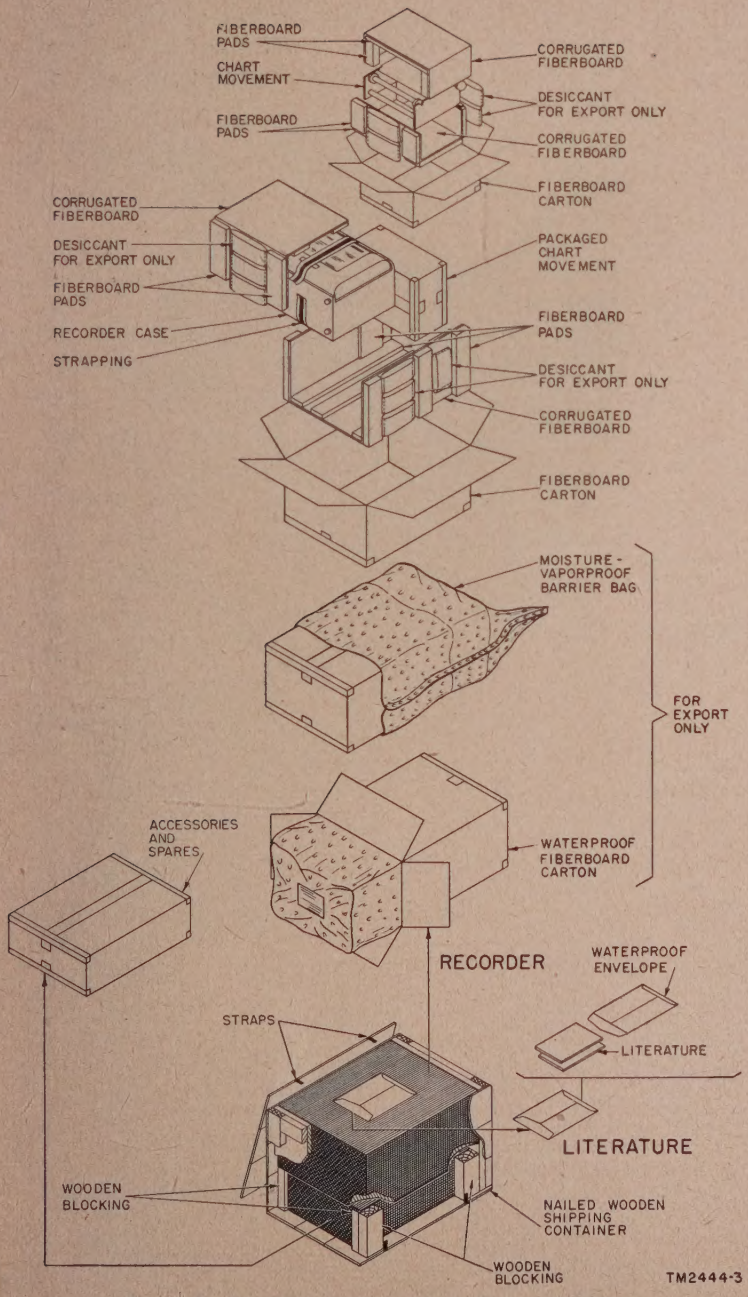


Figure 3. Recorder, packing and packaging diagram.

b. The equipment in the wooden box is packaged in two separate fiberboard containers. The larger container incloses the recorder case and the chart drive mechanism, each of which is wrapped separately. The smaller fiberboard box contains the spare parts, power cable, and

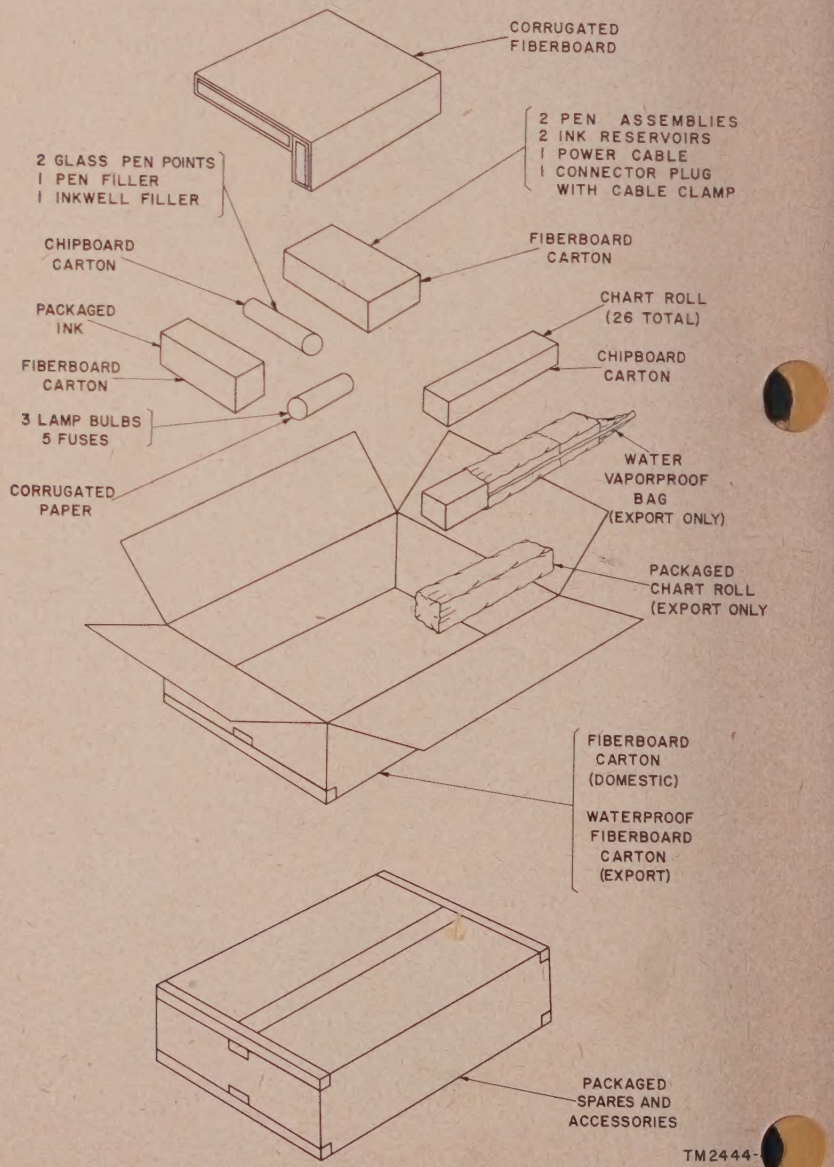


Figure 4. Packaging and packing of accessories and spares.

accessories, which also are wrapped individually. Figures 3 and 4 illustrate the packaging details and the differences between export and domestic packaging.

9. Difference in Models

The RO–2 GMQ and the RO-2A GMQ are similar in all respects, except for the following differences in the chart drive mechanism:

a. The chart drive mechanism (fig. 11) for the RO 2 GMQ has an ac chart drive motor which operates from a 105- to 125-volt ac, 60-cycle, single-phase power source.

b. The chart drive mechanism (fig. 12) for the RO 2A/GMQ has a dc chart drive motor. The electrical power (105- to 125-volt ac, 50- to 65-cycle, single-phase power source) for the motor is supplied through a 115-volt/8-volt power transformer and a full-wave selenium rectifier.

CHAPTER 2
INSTALLATION

10. Uncrating, Unpacking, and Checking New Equipment (figs. 3 and 4)

To uncrate, unpack, and check the equipment, proceed as follows:

a. Cut the metal straps that bind the wooden case, and remove the straps.

b. Use a nail puller to remove nails from the top of the case. Remove the top.

c. Lift out the sealed envelope that contains the technical literature and lift out the two fiberboard boxes.

d. If packaged for export, remove the barrier box and the barrier bag from the large package, to expose the fiberboard box.

e. Open the box and lift out the recorder and the fiberboard box containing the chart drive mechanism for the recorder.

f. Remove the metal strap from around the recorder.

g. Take the chart drive mechanism out of the fiberboard box.

h. Open the fiberboard box containing the spare parts and accessories and remove the contents.

i. Open all packages except the packages that contain the charts. Open only one chart package at this time. The remaining 25 packages that contain the spare charts are to be opened as needed.

j. Remove the tapes used to hold components rigid inside the recorder during shipment.

k. Examine each item of the equipment carefully to be sure that it has not been bent, broken, or otherwise damaged in shipment.

11. Siting

Choose a location in an area that is protected from bad weather conditions. Allow enough room for the connection of external cables, the opening of the door, removal of the chart takeup reel, and examination of the record as described in paragraph 20. When choosing the location, the distance between the transmitter and the recorder is an important factor. Therefore, the following should be taken into consideration:

a. To be sure of accuracy of the speed record, the direct-current (dc) resistance of the two conductors for the speed circuit in the cable con-

necting the recorder and the transmitter should not exceed 3.2 ohms per conductor.

b. The following chart may be used as a guide in determining these distances. This chart lists the minimum wire sizes for these two speed conductors in various lengths of cable. It also gives the percent of error introduced into the speed circuit by these various wire sizes per 1,000 feet of cable.

Note. The 5,000 foot cable with the 8 conductors as indicated in the chart is furnished with the AN GMQ-11 and is the cable used in the installation. The other cables listed in the chart are for emergency use only.

Cable length (ft)	Cable		Per cent of error at 25° C. or 77° F.
	No. of cond.	Wire size (AWG)	
5,000	2	10	—0.753
	3	14	
	3	16	
3,000	3	12	—0.753
	2	16	
	2	20	
2,000	2	14	—0.822
	6	20	
1,200	2	14	—0.47
	6	20	
750	2	14	—0.273
	6	20	
500	2	16	—0.273
	6	20	
300	7	20	—0.47
300	8	16	—0.205
300	4	16	—0.205
	4	20	

Note. Each installation of the equipment will be provided with cable, in such quantities as may be necessary to meet the requirements of the particular installation, and with 24 terminal lugs.

12. Installation of Recorder

The recorder may be mounted on a table or vertically on a panel.

a. Panel Mounting. Mount the recorder on any vertical surface as follows:

Note. This is a typical mounting. The installation determines the type of mounting.

(1) Use boards nailed together or plywood to form the panel. The thickness of the wood depends on the material available but it should be strong enough to support the recorder.

(2) Make the panel approximately 3 by 3 feet in size.

(3) Refer to figure 5 and drill three holes $\frac{5}{16}$ inch in diameter through the panel wood in accordance with the measurements given. Drill the holes so that the recorder is centered on the panel.

(4) Insert $\frac{5}{16}$–18 screws (length will depend on the thickness of the material used for the panel) through the drilled holes into the threaded mounting holes of the recorder (fig. 5).

(5) Mount the panel (with the recorder attached) on a vertical surface, such as a wall or posts, with nails or screws (this procedure will be determined by the type of installation). It must be mounted high enough for the operator to read the recordings easily and also to have ready access to the chart drive mechanism and controls.

b. Table Mounting. When the recorder is table mounted, it need not

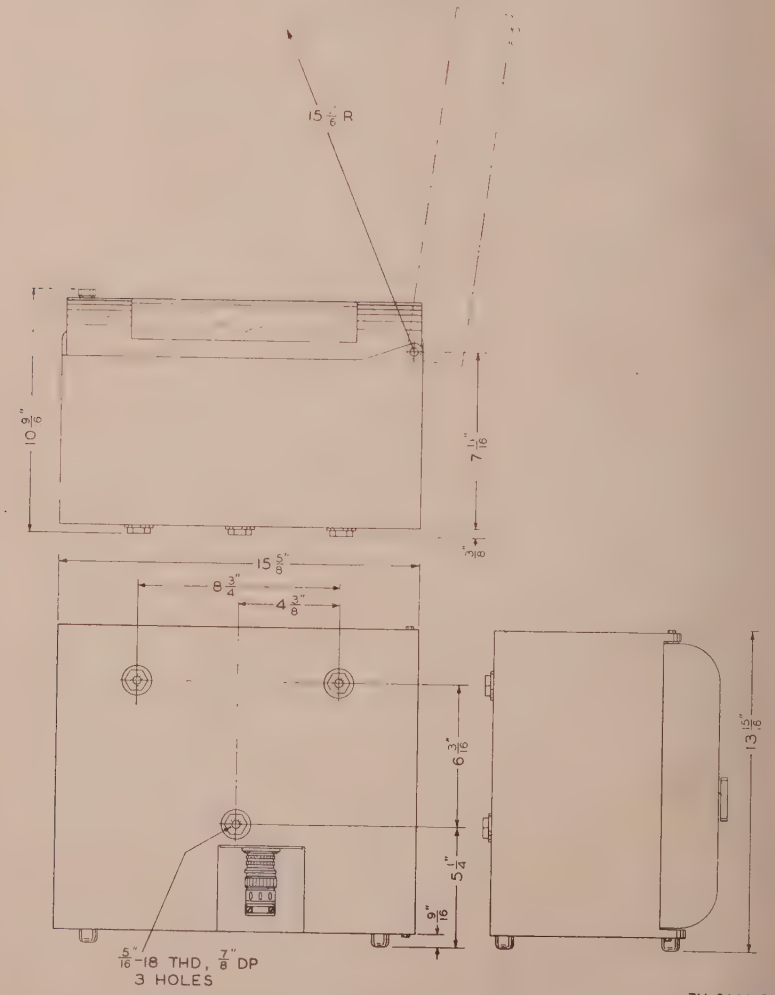


Figure 5. Mounting dimensions.

be fastened down. It is provided with rubber feet to prevent slipping and also to help eliminate shocks and jars. Place it on a level surface that is as free as possible from vibration and that is sturdy enough to insure against tipping over or tilting. Be sure there is enough room for the connection of the cables to the recess in the rear bottom of the case (fig. 6).

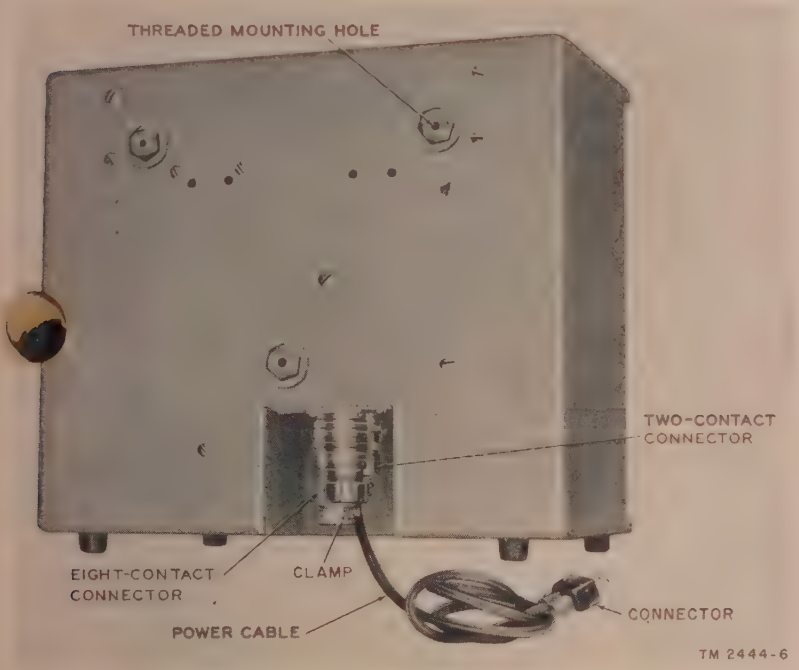


Figure 6. Recorder, rear view, showing threaded mounting holes and cable connectors.

13. Connections

The recorder may be connected to a transmitter (fig. 7) or it may be connected to a transmitter and an indicator (fig. 8). The installation dictates the type of hookup. If there is a remote station on a hill or the side of a hill (somewhat distant from the regular meteorological station) where readings are taken only at periodic intervals, the recorder and transmitter hookup is used. In other meteorological installations, the recorder can be connected to both the indicator and the transmitter. The procedure for connecting the recorder to the transmitter is described in *a* below; the procedure for connecting the recorder to the transmitter and the indicator is described in *b* below.

Note. Refer to TM 11-2443, Wind Measuring Set AN/GMQ-11, for information regarding description, installation and operation of the wind measuring set.

a. Connecting Recorder to Transmitter (fig. 7). If only a recorder and transmitter are used, connect them as follows:

(1) If the recorder is to replace a properly functioning indicator (part of Wind Measuring Set AN/GMQ-11), tag each conductor at the indicator end of the transmitter cable with the corresponding terminal numeral on terminal board TB201 (fig. 8) before removing the cable from the indicator. The tag number on each conductor is the same as the pin number of connector J1 to which that particular conductor is connected in the transmitter.

(2) If the recorder is to be connected to the free end of the transmitter cable, remove connector J1 from the transmitter and, by color code or continuity check, tag the free end conductors of the cable with the pin numbers to which they are connected. Reassemble connector J1 to the transmitter.

(3) Unscrew the cable clamp (fig. 6) from the eight-contact connector.

(4) Solder the cable to eight-contact connector P403 (fig. 7). Connect the conductors in rotation with the pin letters; that is, A of P403 is connected to conductor tagged *1*; B is connected to *2*, etc.

(5) If the cable is color-coded, note the color code on the wiring diagram (fig. 7) for future reference.

(6) Plug eight-contact connector P403 into connector J403 in the recorder.

(7) Be sure that shunt resistor R403 (fig. 9) is installed as shown in figure 7.

b. Connecting Recorder to Transmitter and Indicator (figs. 8 and 9). If a transmitter and indicator are to be used with the recorder, connect them in accordance with the following instructions:

(1) Remove power cable W202 from terminal board TB201 of the indicator.

(2) Coil power cable W202 and store it inside the indicator case for future use.

(3) Remove the jumper across terminals 7 and 8 on terminal board TB201 in the indicator. Store the jumper inside the indicator case.

(4) Remove one lead on resistor R201 from terminal 6 or 7 of terminal board TB201 in the indicator. Tape the removed lead to electrically insulate it; leave the other lead attached to the terminal board to prevent loss of the resistor.

(5) Remove one lead on resistor R403 from terminal V1 or V2 terminal board TB402 (shows below the shunt resistor on

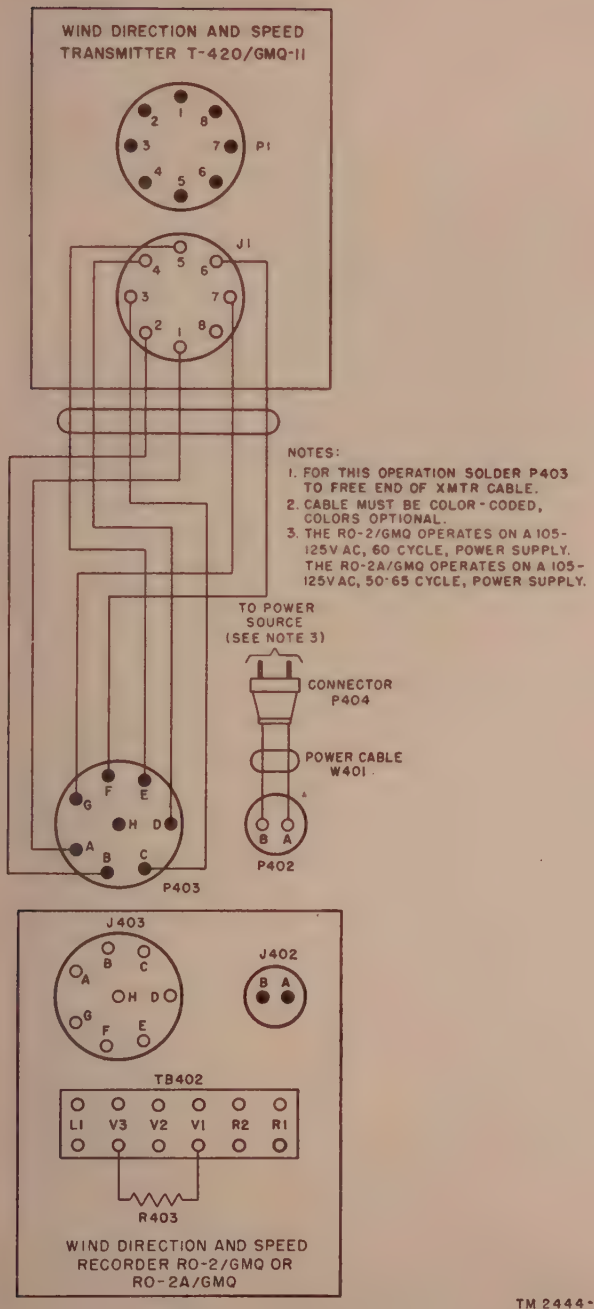

WIND DIRECTION AND SPEED
TRANSMITTER T-420/GMQ-11
P1
J1
NOTES:
1. FOR THIS OPERATION SOLDER P403 TO FREE END OF XMTR CABLE.
2. CABLE MUST BE COLOR-CODED, COLORS OPTIONAL.
3. THE RO-2/GMQ OPERATES ON A 105-125V AC, 60 CYCLE, POWER SUPPLY. THE RO-2A/GMQ OPERATES ON A 105-125V AC, 50-65 CYCLE, POWER SUPPLY.
TO POWER SOURCE (SEE NOTE 3)
CONNECTOR P404
POWER CABLE W401
P402
P403
J403
J402
TB402
L1 V3 V2 V1 R2 R1
R403
WIND DIRECTION AND SPEED RECORDER RO-2/GMQ OR RO-2A/GMQ
TM 2444-7

Figure 7. Connection diagram, recorder and transmitter.

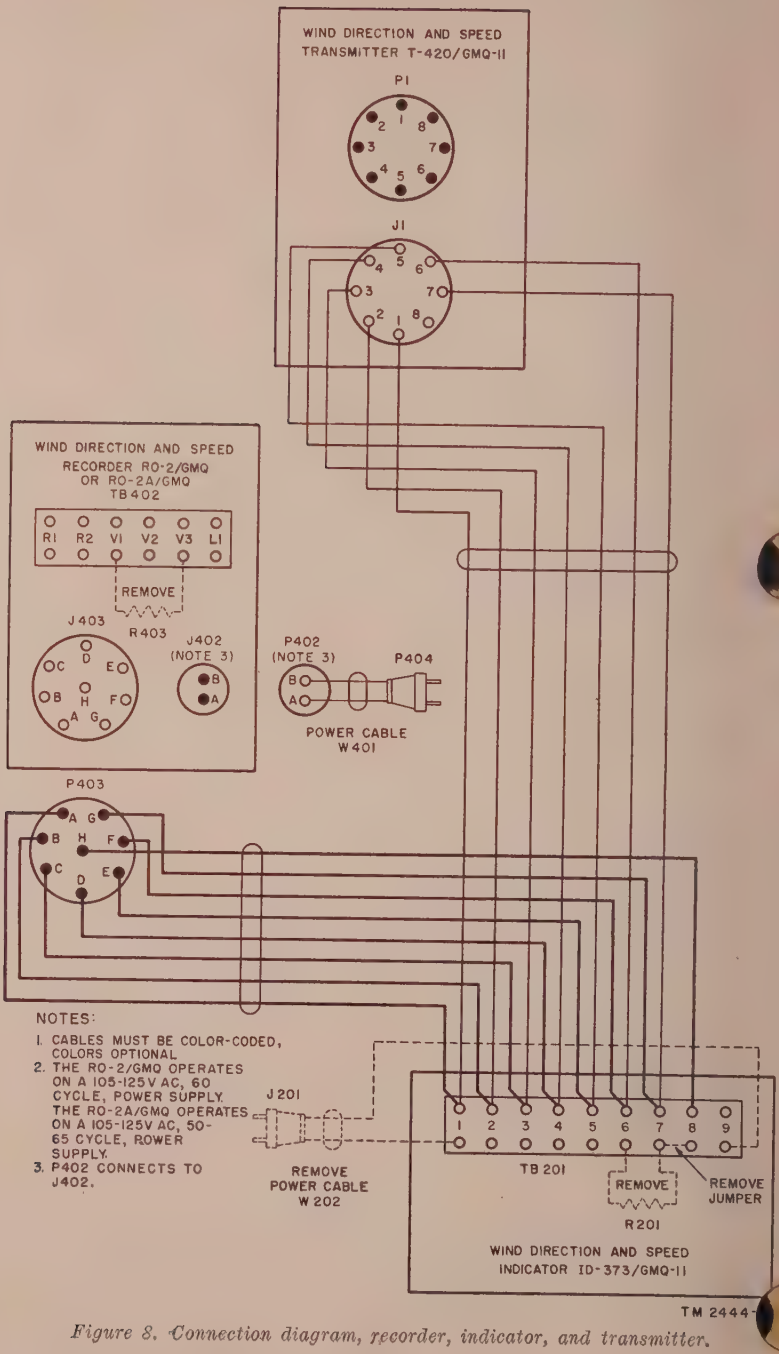


Figure 8. Connection diagram, recorder, indicator, and transmitter.

ure 9) in the recorder. Tape the removed lead to electrically insulate it; leave the other lead attached to the terminal board to prevent loss of the resistor.

(6) Attach an eight-conductor cable to terminal board TB201 in the indicator. Be sure the two No. 10 speed conductors are attached (one each) to terminals 6 and 7.

(7) By continuity check or color code, tag each conductor at the free end of the cable with the number of the terminal to which it is connected in the indicator.

(8) Remove the eight-contact connecter (fig. 6) from the recorder and unscrew the cable clamp.

(9) Solder the free ends of the eight-conductor cable to the eight-contact connector. Solder the two No. 10 speed conductor leads (one each) to pins G and F of the eight-contact connector. (These are the two dc (plus and minus) speed conductors.) Connect the remaining conductors in rotation with the pin letters; that is, A of the eight-contact connector to the conductor tagged *1*; B to *2*, etc. Color coding of the conductors will assist in this procedure.

(10) Plug in the eight-contact connector as shown in figure 6. (P403 plugs into J403, fig. 8.)

Caution: Avoid using two power cables (indicator and recorder) to prevent possible short circuit and injury to equipment and personnel.

14. Service Upon Receipt of Used or Reconditioned Equipment

The methods of packaging, packing, storing, or shipping recorders, as described in this publication, are the same for used or reconditioned equipment as for new equipment. However, the operator should inspect the equipment for completeness. Check the wiring in accordance with the schematic diagrams (figs. 38 and 39). Note any tags that may be present to indicate wiring changes.

CHAPTER 3
OPERATION

15. Controls and Their Uses

The following chart lists the equipment controls. Do not attempt to operate the equipment until the use of the controls is fully understood.

Control	Fig. ref	Function
POWER WITH LIGHTS OFF-POWER WITHOUT LIGHTS switch (power and lights switch).	9	Turns the equipment on with lights, on without lights, or off.
ON-OFF switch (chart movement)	15	Supplies power to the chart dr motors.
0 240K-MULTIPLY KNOTS X2 0–120K switch (dual range switch).	9	Selects wind speed recording range, also disconnects wind speed meter.
Direction pen adjustment lever	9	Adjusts direction pen position (zeroing) (par. 34).
Speed pen adjustment lever	9	Adjusts speed pen position (zeroing) (par. 34).
Operations levers	13	Raise or lower chart guide-pen lift mechanism.
Chart set knob	13	Sets correct time line on the chart (par. 18*b*).

16. Ink Tanks
(fig. 10)

a. Fill both ink tanks about ¾-full through the pen opening; use the ink and ink tank filler furnished with the recorder. Do not use standard writing inks. Keep the bottle tightly capped to prevent dirt from getting into the ink.

b. Raise the scale plates and insert the ink tanks in the receptors on top of the speed and direction mechanism assemblies (fig. 2), and see that they are under the spring clips (fig. 21) that hold them in place.

c. Set the pen elements in the pen element forks (penholder) (fig. 21) by seating the knife edges (fig. 10) of the pens into the slots of the fork.

Note. The ink tanks and pens may be installed or removed for servicing when chart drive mechanism is removed, tilted-forward, or is in its operating position.

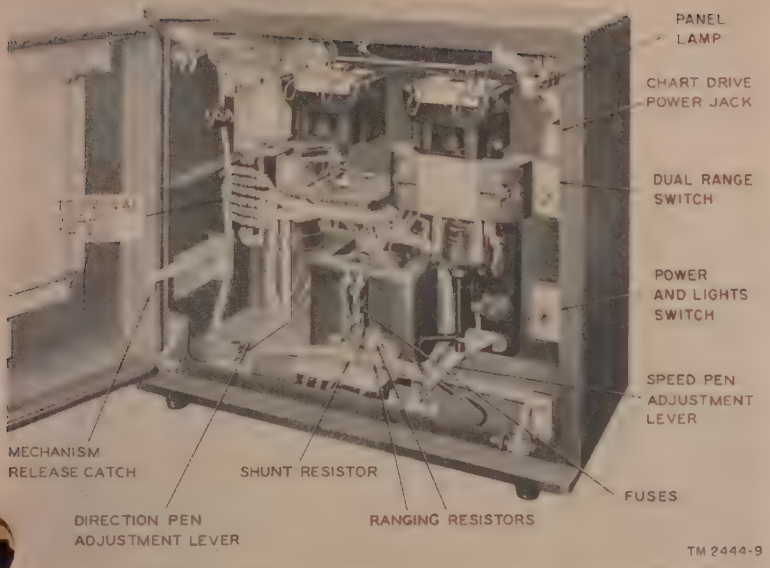


Figure 9. Case interior, chart drive mechanism removed, showing location of controls.

17. Preliminary Adjustments, Charts and Pens

a. Changing Chart Speeds (fig. 11). The recorder is equipped with chart drive gears to give a chart speed of 3 inches per hour, which matches the time graduations of the chart supplied. Change gears (20), to provide a chart speed of 6 inches per hour, are mounted on a stud (19) on the left side plate of the chart drive mechanism. The change gear arrangements below show the combination of gears to obtain the different rate of chart speed. To change the rate of chart speed, proceed as follows:

(1) Unscrew the change gear nuts (28 and 29) from their shafts and pull off the existing gears (21).

(2) Remove the stud (19) and remove the gears (20).

(3) Slide the desired gears on (20) and replace the nuts (28 and 29); be careful to engage the slots in the gear hubs with the keys on the shafts.

(4) Be sure that the change gear nuts (28 and 29) are screwed on tightly and that the removed gears are placed securely on the storage stud (19). The change gear arrangements are as follows:

Chart speed (in. per hr)	On drive roll shaft (3, fig. 11) use gear marked	On intermediate gear stud (31, fig. 11) use gear marked	Approximate running time (days)
3	36T	36T	15
6	24T	48T	7½

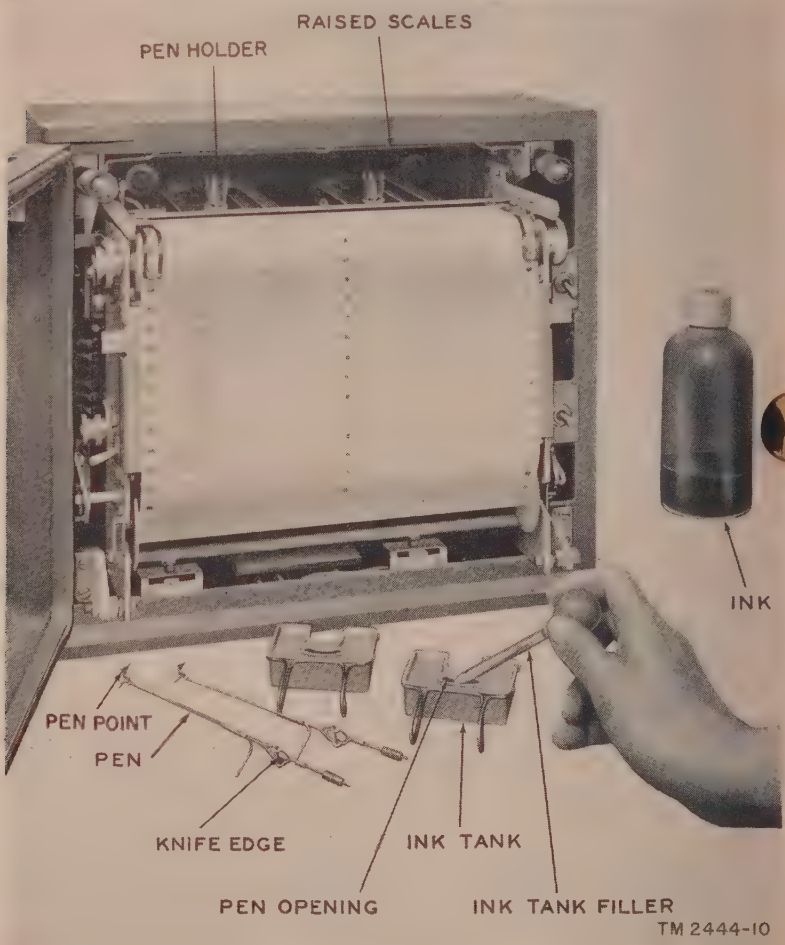


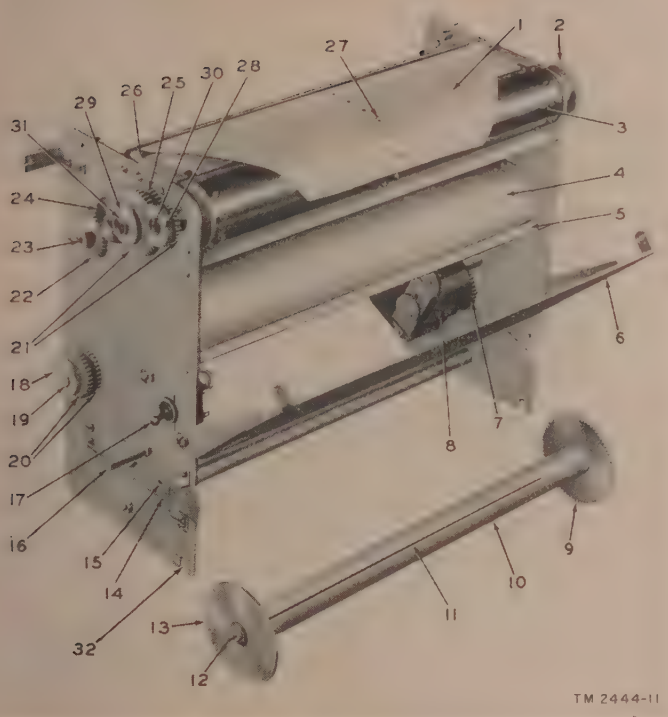
Figure 10. Filling ink tanks.

b. Installing Chart Drive Mechanism (fig. 13).

(1) Lift up the operation levers.

(2) Place the chart drive mechanism in the recorder (fig. 13) so that the pivot slots (32, fig. 11) in the mechanism side plates are seated on the pivots (fig. 16).

(3) Place the mechanism in its normal operating position (fig. 1



1	Chart.	12	Pivot	23	Motor shaft (chart drive motor hidden).
2	Chart set knob.	13	Flange.	24	Idler gear.
3	Drive roll.	14	Catch.	25	Intermediate gear.
4	Chart supply roll.	15	Pivot hole.	26	Idler roll.
5	Trough.	16	Stud.	27	Sprocket pin.
6	Panel.	17	Switch.	28	Change gear nut.
7	Gear.	18	Nut	29	Change gear nut.
8	Take-up motor.	19	Stud.	30	Drive roll shaft.
9	Gear.	20	Change gears.	31	Intermediate gear stud.
10	Take-up reel.	21	Change gears.	32	Pivot slot.
11	Slot.	22	Motor drive gear.		

Figure 11. Chart drive mechanism (RO–2/GMQ), left view.

(4) Lower the operation levers over the chart drive roll (fig. 16).

c. Chart Installation. To install the chart, proceed as follows:

(1) Lift the operation levers and pull the chart drive mechanism forward (fig. 13).

(2) Open the front panel (6, fig. 11).

(3) Cut the corners from the end of the chart (fig. 13).

(4) Before installing the supply roll, thread the chart upward (fig. 14) through the space between the trough and idler roller and then over the sprocket pins of the drive roll.

(5) Place the chart supply roll in the trough; wind up the slack of the chart at the same time.

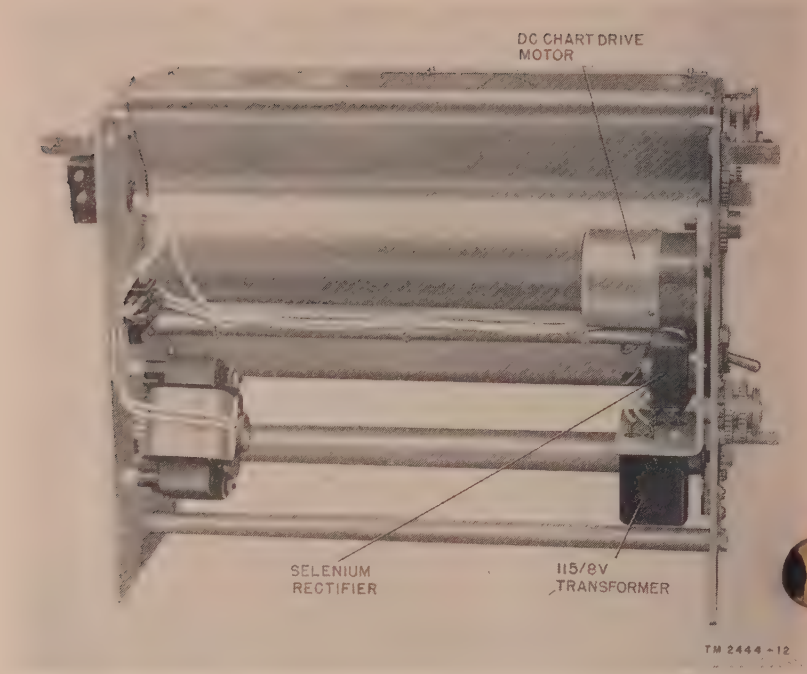


Figure 12. Chart drive mechanism (RO–2A/GMQ), rear view.

(6) Close the front panel (fig. 13).

(7) Pull the chart over the drive roll (fig. 13).

(8) Insert the tapered end of the chart into the slot of the take-up reel; wind several turns of the chart on the reel (printing on the outside (fig. 15)).

(9) Insert the pivot on the gear end of the reel into its bearing hole (fig. 15). Insert the left pivot in the bearing hole of the flat spring catch. If the reel does not install easily, the gears may not be meshing properly; turn slightly to remedy.

(10) After the chart has been installed, return the chart drive mechanism to its normal operating position and lower the operation levers (fig. 16).

(11) Pull the indication scales down so that they are in position for viewing (fig. 1).

d. Filling Pen (fig. 16). Fill the pen with the pen filler furnished with the recorder; proceed as follows:

(1) Squeeze the bulb of the pen filler; lay the flat side of the soft rubber tip on the chart. Insert the glass pen into the hole in the rubber tip and let the filler suck in ink from the ink tank through the pen until no bubbles are visible in the glass pen.

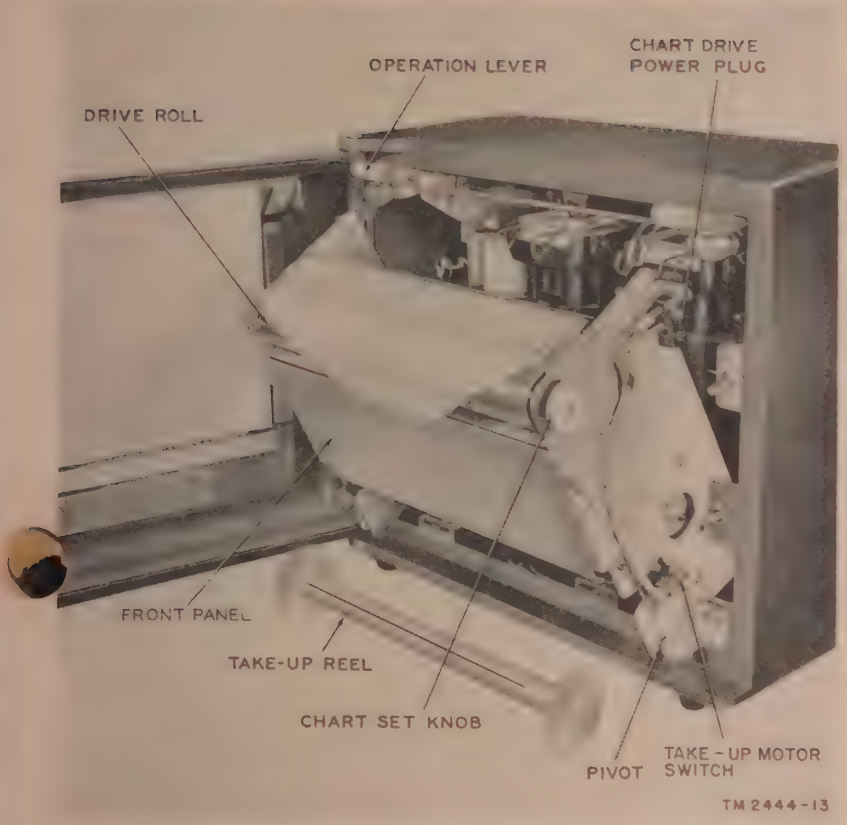


Figure 13. Installing chart drive mechanisms and chart.

(The pen feeds from the ink tank by capillary action once it is filled.)

(2) Remove the pen element from the filler. The pen should rest lightly on the chart.

(3) Swing the pen across the chart a few times. If it does not write properly, the pen probably has an air bubble in it, in which case the pen filling operation must be repeated.

Note. Do not apply power to the recorder when swinging the direction pen.

(4) Be sure that the pen is seated properly and that it does not rub on the ink tank. Also check to see that it does not rub on the indication scales and the pen lift bar when they are in their operating positions. The indicating flag above the glass pen must not touch the scale plate.

Note. The pen element is balanced correctly at the factory when full of ink and will stay off the chart until the pen is filled.

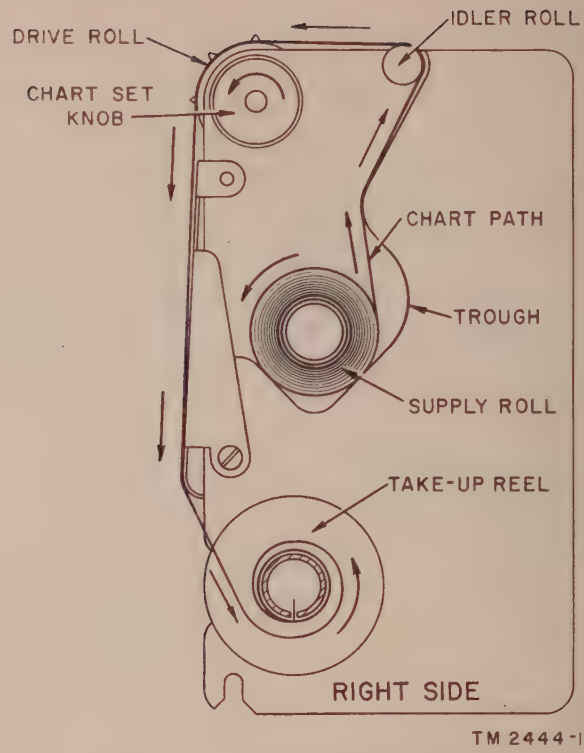


Figure 14. Chart threading diagram.

18. Time Setting Chart

a. Before setting the chart with reference to time, make the following checks:

(1) See that the desired change gears are installed correctly, and that the spare gears are fastened securely on the storage stud (par. 17 and fig. 11).

(2) See that the chart is installed properly (par. 17*c*).

(3) See that the chart drive mechanism is returned to its normal operating position with the chart guides down over the chart guide sprockets, the pens resting on the chart, and the indication scales pulled down so that they are in position for viewing.

(4) Install the power cable (fig. 6) in the recorder and plug it in the power source.

(5) Place the chart movement ON-OFF switch (fig. 15) in the ON position.

(6) Turn the power and lights switch (fig. 9) to the desired (position.

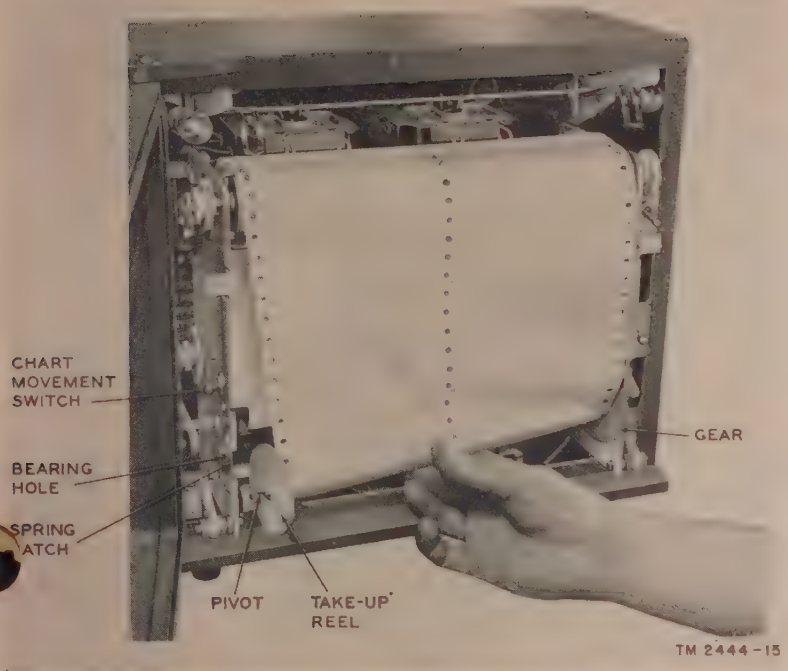


Figure 15. Installing takeup reel.

b. Turn the chart set knob (fig. 13) until the correct time line on the chart is under the pens.

Note. After time setting the chart, do not tilt the chart drive mechanism forward; power supplied to the chart drive motors will be interrupted, thus losing the time setting.

19. Preoperational Check

Be sure the switches are turned on (par. 18*a*(5) and (6); then follow the procedures outlined in *a* and *b* below before using the procedures described in paragraph 20.

a. Wind Direction Mechanism.

(1) Position the vane of the transmitter to the northerly direction.

(2) Check to see that the direction pen indicates 360° (not 0°).

(3) Slowly turn the vane through at least 540°; first in one direction then in the other.

(4) Check to see that the pen follows in the correct direction at all times.

b. Wind Speed Mechanism.

(1) While the impeller of the transmitter is turning counterclockwise (facing the impeller), check to see that the speed pen moves to a speed indication.

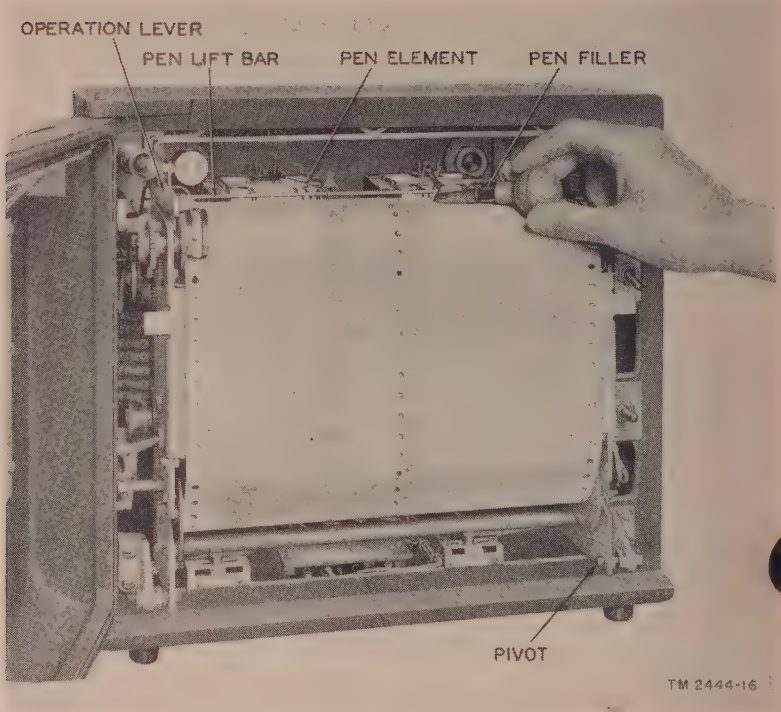


Figure 16. Filling pens.

(2) When the impeller is stationary, check to see that the speed pen indicates zero.

20. Operation

To operate the recorder, be sure the switches are turned on in accordance with the instructions in paragraph 18*a*(5) and (6); then proceed as follows:

a. Examine the chart according to the instructions listed in paragraph 17*c*. Replace the chart when necessary.

b. Inspect the ink tanks (par. 17*a*). Add fresh ink weekly.

c. Operate the pens (par. 17*e*). Draw a small amount of ink through the pens with the pen filler weekly. This will loosen any clogged or stiffened ink.

d. Operate the dual range switch (fig. 9) on the O–120K range position unless high wind intensities (over 90 knots) are being experienced or are expected. When the O–240K range position is used, the indicator speed meter (if used) is removed automatically from the circuit.

e. The chart may be used with the 3-inch or 6-inch per hour cha speed and the time lines are graduated to 10 minutes and numbere

every hour. Use the chart drive mechanism on the 3-inch per hour chart speed except when it is desirable to secure more detailed wind and gust data. The chart has a running time of approximately 15 days when used on the 3-inch per hour chart speed and $7\frac{1}{2}$ days when used on the 6-inch per hour chart speed. The time lines do not correspond with the 6-inch per hour chart speed. Therefore, the time must be divided by 2 to compensate when this speed is used.

f. To unroll the chart record from the takeup reel while the chart mechanism is operating, grasp the chart on either side, near the takeup reel, and pull it from the reel. See that the chart is kept straight and taut as it is allowed to rewind on the reel.

g. Observe the chart and scale.

h. Remove the chart from the takeup reel (figs. 11 and 13) by first removing the reel from the recorder. Then pull the plain flanged end from the core of the reel. Slide the chart off the core.

i. To install a new chart, slide it on the core of the reel; replace the plain flanged end of the reel and follow directions in paragraphs 17*d* and 18.

j. Stop the equipment from operating by moving the power and lights switch (fig. 9) to the OFF position.

k. Remove the connector (fig. 6) of the power cable from the power source receptacle.

21. Operation Under Unusual Conditions

It may be necessary to operate the recorder in regions where extreme cold, heat, humidity, moisture, or sand conditions prevail. The recorder will operate in a temperature range from —10° F. to +125° F., in a relative humidity range from 0 to 95 per cent, and in an elevation range from 0 to 10,000 feet. Instructions for minimizing the effect of unusual operating conditions are contained in *a* through *c* below.

a. Arctic Climates. Subzero temperatures and climatic conditions associated with cold weather affect the operation of the recorder. Observe the following instructions and precautions:

(1) Handle the equipment carefully.
(2) Keep the equipment as warm and dry as possible.
(3) Locate the equipment inside a heated inclosure, if possible.
(4) Keep the illuminating lamps of the recorder lighted to prevent the ink from stiffening.
(5) Keep moisture from the equipment. Dry thoroughly if moisture appears.

b. Tropical Climates. When operating in tropical climates, observe the following:

(1) Locate the recorder inside a shelter which will keep out the rain.
(2) Keep the shelter well ventilated.

(3) Keep moisture (caused by condensation) from the equipmen by lighting the recorder's illuminating lamps.

(4) When possible, light other electric lamps near the equipment. These lamps will help to keep the equipment dry.

c. Desert Climates. The main problem that arises with equipment operation in desert areas is the amount of sand, dust, and dirt that enters moving parts of the recorder. To minimize these problems, observe the following:

(1) When possible, house the equipment in a dustproof shelter.

(2) When a dustproof shelter is not available, make the shelter as dustproof as possible by hanging wet sacking over the windows and doors and by covering the inside walls with heavy paper.

(3) When the recorder is housed in a tent, use sand to secure the outside walls to prevent their flapping in the wind.

CHAPTER 4
ORGANIZATIONAL MAINTENANCE

Section I. PREVENTIVE MAINTENANCE SERVICES

22. Definition of Preventive Maintenance

Preventive maintenance means making systematic checks and adjustments at regular intervals to keep equipment operating at top efficiency. It is not the same as troubleshooting or repair. The purpose of preventive maintenance is to *prevent* breakdowns and the need for repair. The purpose of troubleshooting and repair is to locate and *correct existing defects*. The importance of preventive maintenance cannot be overemphasized. Failure or inefficient operation of one piece of the equipment may cause the failure of an entire system. It is vitally important, therefore, that operators and repairmen maintain their equipment properly.

23. Tools, Materials, and Test Equipments Required

a. The following tools and materials are required to perform preventive maintenance.

Item	Function
Alcohol	Cleans ink tanks and pens.
Lint-free cloth	Cleans equipment.
Multimeter TS–297/U	Used for continuity tests.
Screw Driver TL–333/U	Tightens, removes, or replaces screws.
Soldering Iron TL–117	Used for soldering wires to connectors and terminals.
Wire, .008" to .010", 2 ft.	Cleans pens and removes glass pen points.

b. The following accessories are supplied with the recorder and are used for filling the pen and the tank in accordance with instructions in paragraphs 16 and 17:

(1) Pen filler.

(2) Ink tank filler.

24. Preventive Maintenance Techniques

Proceed as follows when performing preventive maintenance on the recorder:

a. Inspecting. Before performing the regularly scheduled preventive maintenance, inspect the recorder in operation; be particularly careful of the pens and chart mechanism. Check the time setting of the chart

and the writing of the pen. Intermittent writing, failure of the pen to write on sudden swings, or a tendency of the ink to spread on the chart and produce a broad, fuzzy line are indications that the ink in the system needs replacing and the system needs to be cleaned according to the instructions in *c* below.

b. Cleaning Electrical Parts. Do not clean electrical parts at organizational level.

c. Cleaning Mechanical Parts.

(1) Wash exterior painted surfaces and the window with soap and water; rinse and dry thoroughly. Do not wash the inside of the case.

Caution: Do not clean the windows with a solvent, since minute cracks may result.

(2) Clean the ink tanks by first removing them from their receptacles (par. 16). Pry off the cover and be sure not to bend it; wash the parts in warm water; rinse and dry thoroughly. If washing does not remove all of the dried ink, loosen the remainder by soaking in alcohol; then wash again. Be sure the vent holes in the cover are open.

(3) Clean the pen element by blowing water or alcohol through it with the pen filler. Loosen clogged ink particles that block the pen by running a fine wire (.008 inch to .010 inch) through the tube and then clean again.

(4) If necessary, replace the glass pen point as follows:

(*a*) Remove the point by twisting it and pulling it out. (The glass pen is a taper fit in a metal pen tube.)

(*b*) If the pen sticks, heat the tube around the pen to get the pen loose. (Use boiling water.)

(*c*) If the pen is broken off in the pen tube, remove it by running a fine wire (.008 inch to .010 inch) through the broken pen, tying a small knot in the wire, and then pulling the broken pen out with the wire.

Note. The glass pen point is factory-ground to give a suitable line. If a wider line is desirable, grind the point with a fine stone wet with water. Two spare points are furnished with the equipment.

(*d*) Insert the new glass pen point into the tube; be sure the point rests perpendicularly to the chart, otherwise it will not write properly.

d. Adjusting. Adjust the wind direction and wind speed pen settings according to instructions in paragraph 34.

25. Preventive Maintenance Checklist

The following checklist shows preventive maintenance procedures for the equipment. The list indicates what to check, when to check, how to check, and remedies to be taken after checking.

Item No.	What to check	When to check	How to check	Remedies
1	Pens	Daily	Inspect for intermittent writing.	Clean. Refill ink tanks and pens (par. 24*c*(2) and (3)).
			Inspect for failure of the pen to write on sudden swings.	Replace pen point (par. 24*c*(4)).
			Inspect for tendency of the ink to spread on the chart and produce a broad fuzzy line.	Replace pen point (par. 24*c*(4)).
2	Chart	Daily	Inspect to see that the time setting of the chart is correct.	Reset with chart set knob (fig. 13).
3	Window and case exterior	Monthly	Inspect for accumulation of dust or corrosion.	Clean (par. 24*c*(1)).
4	Inking system	Monthly	Check pens for clogging. Check ink tanks for thick ink or dried ink on sides.	Clean inking system (par. 24*c*(2) and (3)). Refill ink tanks (par. 16). Refill pens (par. 17*d*).
5	Wind direction mechanism	Quarterly	Check to see that the pen follows in the correct direction at all times.	Perform check (par. 19*a*).
			Check pen to see that it returns to the 360° position on chart.	Adjust (par. 34*a*).
6	Wind speed mechanism	Quarterly	Check to see that the speed pen indicates zero when the impeller of the transmitter is stationary.	Perform check (par. 19*b*). Adjust (par. 34*b*).
7	Lubrication points	Quarterly	Check to see if the equipment needs lubrication.	Lubricate (par. 26, figs. 17, 18, and 19).

Section II. LUBRICATION AND WEATHERPROOFING

26. Lubrication of Equipment

The lubrication interval is contained in the preventive maintenance check list (par. 25) and in the chart below. This interval is established for operation on a 24-hour basis under moderate climatic conditions. Whenever climatic conditions necessitate more frequent intervals for general servicing, the lubrication interval should be shortened accordingly. Avoid overlubrication; overlubrication is injurious to the recorder. Inspect the equipment after lubricating and remove all excess oil that will tend to collect dust. Oil may be properly applied by dipping a toothpick in the oil and applying it to the surface to be lubricated. Remove excess oil with a clean, lint-free cloth. Figures 17, 18, and 19 show the parts on the recorder that require lubrication. Follow the instructions above and the information in the chart on p. 33 when lubricating the equipment.

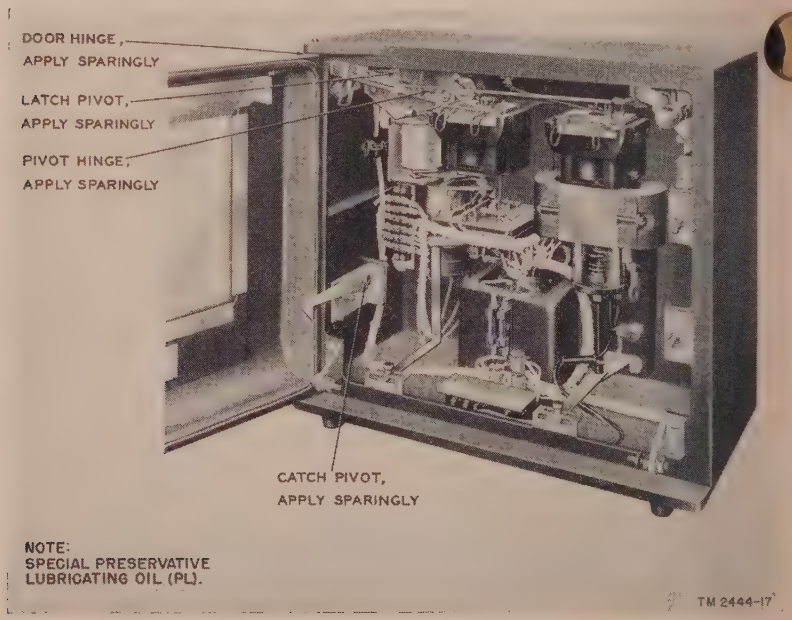

DOOR HINGE, APPLY SPARINGLY
LATCH PIVOT, APPLY SPARINGLY
PIVOT HINGE, APPLY SPARINGLY
CATCH PIVOT, APPLY SPARINGLY
NOTE: SPECIAL PRESERVATIVE LUBRICATING OIL (PL).
TM 2444-17

Figure 17. Lubrication, case interior.

27. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as those prevailing in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungi

Parts to be lubricated	Lubricant	Interval	Fig. ref	Remarks
Door hinge, latch pivot, and pivot hinge	Oil, Lubricating, Preservative, Special (PL Special).	Quarterly	17	Clean part with Solvent, Dry Cleaning (SD). Remove all sand, grease, and lint. Dry before lubricating.
Idler roll bearing, idler gear bearing, drive roll bearing, takeup reel pivots, and motor oil hole.	Oil (PL Special)	Quarterly	18	Clean (as above) only the takeup reel pivots at organizational level.
Idler roll bearing, drive roll bearing, takeup motor hole.	Oil (PL Special)	Quarterly	19	Cleaning with solvent (SD) at organizational level not authorized.

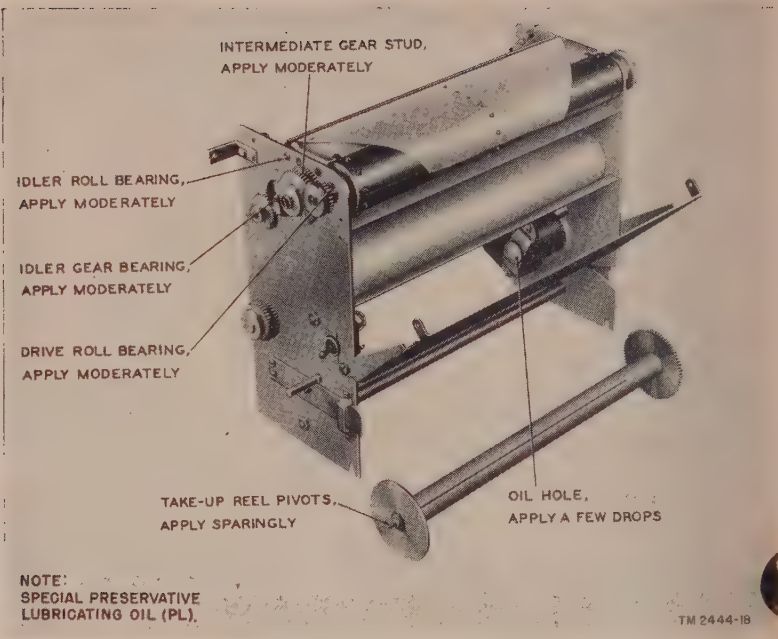

INTERMEDIATE GEAR STUD, APPLY MODERATELY
IDLER ROLL BEARING, APPLY MODERATELY
IDLER GEAR BEARING, APPLY MODERATELY
DRIVE ROLL BEARING, APPLY MODERATELY
TAKE-UP REEL PIVOTS, APPLY SPARINGLY
OIL HOLE, APPLY A FEW DROPS
NOTE: SPECIAL PRESERVATIVE LUBRICATING OIL (PL).
TM 2444-18

Figure 18. Lubrication, chart drive mechanism, left side.

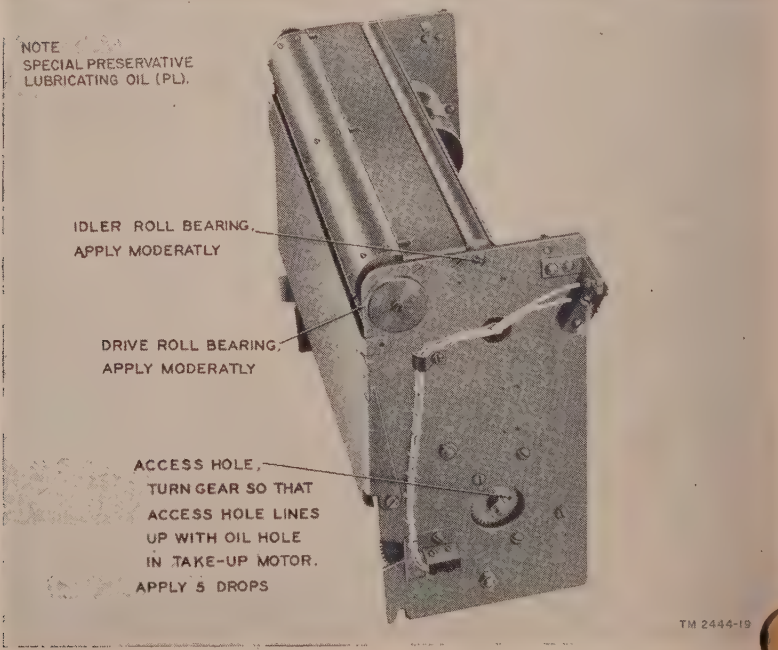

NOTE SPECIAL PRESERVATIVE LUBRICATING OIL (PL).
IDLER ROLL BEARING, APPLY MODERATLY
DRIVE ROLL BEARING, APPLY MODERATLY
ACCESS HOLE, TURN GEAR SO THAT ACCESS HOLE LINES UP WITH OIL HOLE IN TAKE-UP MOTOR. APPLY 5 DROPS
TM 2444-19

Figure 19. Lubrication, chart drive mechanism, right side.

growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, when properly applied, gives a reasonable degree of protection. This treatment is explained in TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, and TB SIG 72, Tropical Maintenance of Ground Signal Equipment.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained in TB SIG 66, Winter Maintenance of Signal Equipment, and TB SIG 219, Operation of Signal Equipment at Low Temperature.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subjected to extremely high temperature, low humidity, and excessive sand and dust are explained in TB SIG 75, Desert Maintenance of Ground Signal Equipment.

28. Rustproofing and Painting

Whenever necessary, the operator will touch up small chips and scratches in the equipment to prevent deterioration from rust. Sand all scratches and chips in the finish of the case with No. 6/0 sandpaper. Be sure all rust is removed before applying paint. Do not use steel wool near the recorder. Minute particles frequently enter the equipment and cause harmful shorting or grounding of circuits.

Section III. TROUBLESHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

29. General

a. Troubleshooting and repairs that can be performed at the organizational level (operator and unit repairmen) are limited in scope by the tools, test equipment, and replaceable parts available, the training of personnel, and the existing tactical situation. Accordingly, this level of troubleshooting is based on the performance of the equipment.

b. Paragraphs 30 through 34 will help to establish whether improper operation of the recorder is a result of a fault in the recorder itself or a fault in the components of the equipment with which it is installed. If a defect in the recorder is indicated, these paragraphs will furnish instructions for repair by organizational personnel or will recommend service by an experienced repairman.

30. Inspection

When beginning a troubleshooting inspection, proceed as follows:

a. Observe whether the power cable (fig. 6) is installed properly and

check to see that it is not frayed, broken, or otherwise damaged.

b. Observe whether the eight-contact connector (fig. 6) is installed properly and check to see that the eight-conductor cable is not frayed, broken, or otherwise damaged.

c. Operate the power and lights switch (fig. 9) to the POWER WITH LIGHTS position. Check to see that the two illuminating lamps are lighted and that the direction pen is in a position that corresponds to the transmitter vane position. If the lights do not light, check the fuses and bulbs.

d. Refer to paragraph 31*a* if an indicator and a recorder are used in the same circuit.

e. Check to see that the chart drive mechanism is seated firmly in its operating position and that the chart is being driven at the proper rate. Check to see that the chart is being taken up on the takeup reel. If the chart drive motors do not operate when the following conditions exist, refer the equipment to higher repair authority.

(1) Mechanism is seated properly.
(2) Chart movement ON-OFF switch is in the ON position.
(3) Power cable is connected to the power source.
(4) Fuses are good.
(5) Power and lights switch is in either on position (POWER WITH LIGHTS OR POWER WITHOUT LIGHTS).

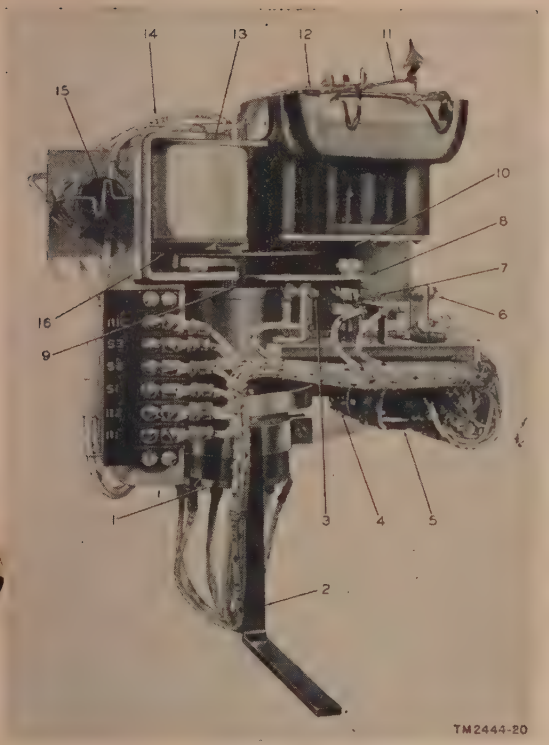
f. Disconnect the eight-contact connector (fig. 6) from the rear of the case, remove the power cable (fig. 6) from the ac power source, and proceed as follows:

(1) Manually move the direction pen across the chart. If the pen does not move easily and smoothly, friction may be present in the synchro, gears, or upper movement assembly. Refer the equipment to higher repair authority.
(2) Manually move the speed pen across the chart. If the pen does not move easily and smoothly, friction may be present in the voltmeter. Refer the equipment to higher repair authority.
(3) Visually inspect the interior of the case for evidence of arcing or pitting on the relay contacts, sliprings, commutator, or switch contacts. See that the relay coils, repositioning motor coils, or resistors do not show evidence of overheating. Refer the recorder to higher repair authority if evidence of the above conditions exists.

31. System Sectionalization
(fig. 20 and 21)

The wind speed and wind direction systems are isolated electrically and troubles in one system should not become apparent in the other system.

a. If an indicator and a recorder are used in the same system, con



1 Synchro.
2 Pen adjustment lever.
3 Adjustable contact.
4 Relay.
5 Relay.
6 Adjustable contact.
7 Center contact.
8 Sector gear.
9 Pinion gear.
10 Pen supporting shaft.
11 Pen.
12 Ink tank.
13 Coil.
14 Coil.
15 Thermal-delay relay.
16 Disk.

Figure 20. Wind direction mechanism.

pare the indications of each with the other. If the indications are the same, the fault does not lie in either the recorder or indicator, but elsewhere in the system.

b. Errors or failures in the wind direction system may be caused by excessive friction in the synchro bearings, loose or reversed cable connections, loose synchro clamp, defective thermal-delay relay, or defective synchros.

c. If the synchro in the indicator or recorder is not free to rotate, it may cause the other synchros in the direction system to overheat and may even cause them to burn out. Refer the equipment to higher repair authority for repair or replacement of synchros.

d. Errors or failures in the wind speed section may be caused by dirty or worn sliprings, defects in the magneto of the transmitter, loose cable connections, excessive friction in the recorder voltmeter, or defects in the recorder range switch, range resistors, shunt resistors, and internal wiring.

Note. Do not attempt to replace recorder parts at this level unless specifically outlined in this chapter.

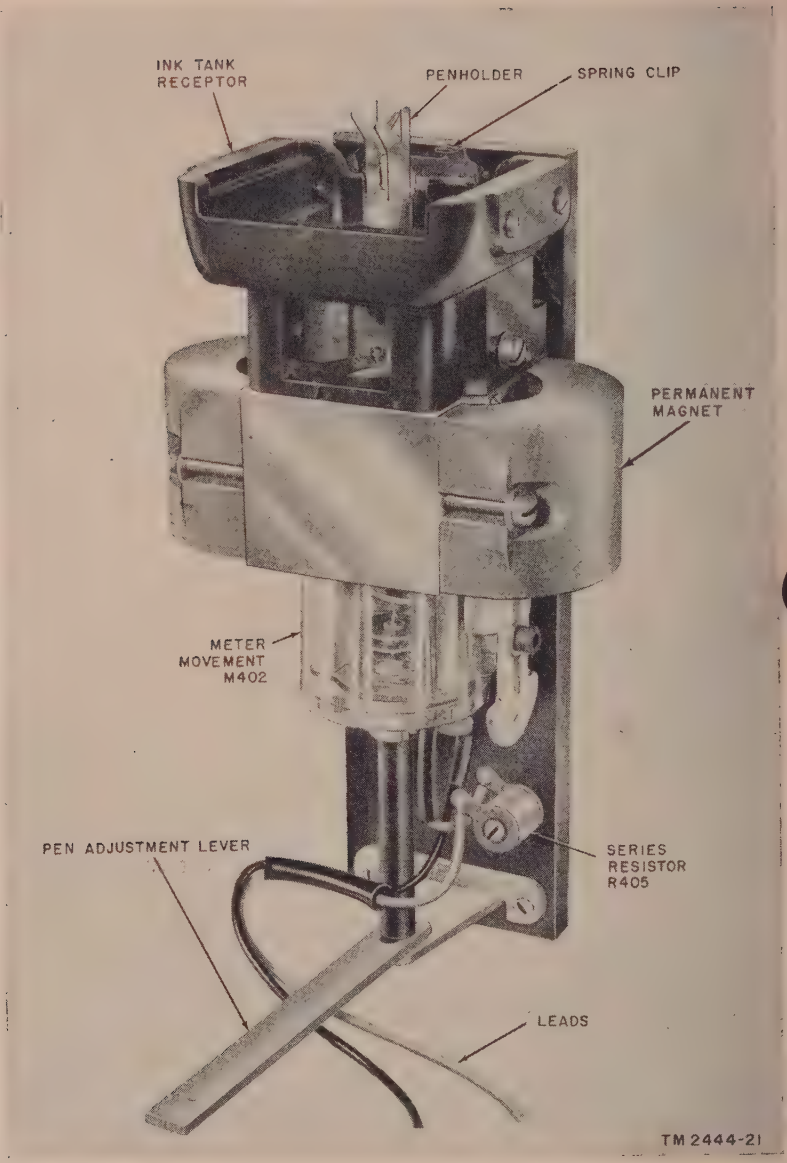


Figure 21. Speed mechanism.

32. Troubleshooting Using Equipment Performance Checklist

a. General. The equipment performance checklist (par. 33) will help locate trouble in the equipment. The list gives the item to be checked, the normal indications of correct operations, and the corrective mea-

sures that can be taken by the operator. *To use this list effectively follow the items in numerical sequence.*

b. Action or Condition. For some items, the information given in the action or condition column consists of various conditions under which the item is to be checked. For other items, it represents an action that must be taken to check the normal indication given in the normal indication column.

c. Normal Indication. The normal indications listed include the visible signs that the operator should perceive when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those which the operator can make. If the set is completely inoperative or if the recommended corrective measurese do not yield results, troubleshooting is necessary. However, if the tactical situation requires that operation be maintained, and if the set is not completely inoperative, the operator must keep the set in operation as long as possible.

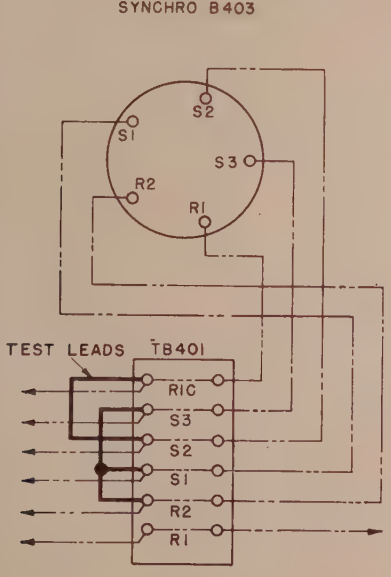


Figure 22. Electrical connection for zeroing recorder synchro B403.

33. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indication	Corrective measures
PREPARATORY	1	Cables	Disconnect connector (fig. 6) at one end of the power cable from the power source. Disconnect the eight-contact connector (fig. 6) from the recorder.		
	2	Power and lights switch (par. 15).	Operate to the OFF position.		
	3	Chart movement ON-OFF switch (par. 15).	Operate to the OFF position.		
	4	Direction pen (par. 5*a*).	Manually move the pen across the chart.	Pen swings smoothly and easily	Refer to higher repair authority for replacement or repair.
	5	Speed pen (par. 5*b*).	Pen is stationary	Pen indicates zero	Adjust (par. 34).
			Move pen back and forth	Pen moves smoothly and easily	Refer to higher repair authority for replacement or repair.
START	6	Cables	Plug the connector of the power cable (fig. 6) into the receptacle of the power source.	Connector should fit into the receptacle.	Repair or replace connector.
			Connect the eight-contact connector (fig. 6) into J403 (figs. 7 and 8) of the recorder.	As above	As above.
	7	Power and lights switch (par. 15).	Operate to the POWER WITH LIGHTS position.	The two small lamps light and illuminate the scale at the top of the recorder cabinet.	Check the lamps. Replace if burned out. Check contacts of lamps sockets. Clean. Check

					the fuses. Replace. Refer to higher repair authority for replacement or repair.
OPERATION	8	Dual range switch (par. 15).	Operate to the 0–120K range position.	Operates the recorder with wind under 90 knots per hour.	Refer to higher repair authority for repair or replacement.
	9	Chart movement ON-OFF switch (par. 15).	Operate to the ON position.	The chart drive and take-up motors (fig. 11) start operating and the chart begins to move from the supply reel over the drive roll to the takeup reel.	Check the reels. Reset properly. Check to see that the chart perforations are placed over the sprocket pins of the drive roll. Reset the chart. Refer to higher repair authority for replacement or repair.
	10	Transmitter vane (on AN/GMQ–11).	Rotate transmitter vane to the approximate cardinal points.	Direction pen rotates to the same compass points and in the same direction.	Refer to higher repair authority for replacement or repair.
	11	Transmitter impeller (on AN/GMQ–11).	Transmitter impeller turning	Pen produces clear trace	Service inking system (par. 24*c*).
STOP	12	Chart movement ON-OFF switch (par. 15).	Operate to the OFF position	Chart mechanism stops operating	Refer to higher repair authority for replacement or repair.
	13	Power and lights switch (par. 15).	Operate to the OFF position.	The two recorder lights go out. Power to the recorder eliminated.	Refer to higher repair authority for replacement or repair.
	14	Power cable (par. 5*h*).	Remove from the power source		

34. Adjusting Direction and Speed Pens

a. Adjusting Direction Pen. To adjust the direction pen proceed as follows:

(1) Turn the power and lights switch (fig. 9) to OFF.

(2) Remove the eight-contact connector from the well in the rear of the case (fig. 6).

(3) Take out the chart drive mechanism (par. 17*b*)

(4) Connect three jumpers (test leads) to TB401 (fig. 9).

(5) Replace the chart drive mechanism (fig. 9) and operate the power and lights switch to the POWER WITH LIGHTS position. The recorder pen should move to the 360° position on the chart.

(6) Correct small positioning errors by loosening the thumbscrew and moving the arm of the direction pen adjustment lever (fig. 9) until the pen indicates 360°.

(7) Retighten the thumbscrew, turn the power and lights switch to the OFF position, and remove the jumpers.

(8) If the adjustment of the pen adjustment lever does not return the pen to the 360° position, refer the equipment to higher authority.

Caution: Do not allow the synchro to be connected to the 115-volt (ac) power source for more than 30 seconds, as serious damage to the synchro may occur because of overheating.

b. Adjusting Speed Pen. With the eight-contact connector removed, loosen the thumbscrew on the speed pen adjustment lever (fig. 9) and adjust the arm so that the wind speed indication is zero. The chart drive mechanism should be turned on for this adjustment. Tap the case lightly to remove residual friction.

CHAPTER 5
THEORY OF OPERATION

Section I. INTRODUCTION

35. General

The recorder provides a continuous record of wind direction and wind speed values with respect to time. It is not used independently of other electrical or mechanical equipments. Electrical values, representing wind direction and speed, must be supplied by a remotely exposed transmitter (par. 3*b*) as the recorder only interprets and records these values; it does not produce them.

36. Equipment Analysis

a. General. To discuss the theory of operation, the recorder has been divided into four systems — wind direction, wind speed, chart drive mechanism, and electrical power. These systems are discussed generally in *b* through *e* below and are discussed fully in paragraphs 37 through 46.

b. Wind Direction (fig. 20). The primary element in the wind direction system is a synchro motor that follows the position of a synchro generator in the remotely exposed transmitter (par. 38). The recorder synchro motor must be free to rotate through 360° in either direction to follow any movement of the transmitter synchro. The pen, however, is limited to movement in a confined arc which matches the arc of the time lines on the chart. Therefore, the pen and synchro are coupled mechanically through a gear reduction. An additional electromechanical circuit is included, which repositions the synchro 1 revolution whenever the synchro brings the pen to the approximate edge of the chart (par. 39).

c. Wind Speed (fig. 21). The wind speed system is a recording voltmeter that measures the wind speed value supplied by the remotely exposed transmitter. The wind speed pen is coupled mechanically to the voltmeter. The addition of ranging resistors and a dual range switch makes possible the recording of wind speeds on a 0- to 120-knot or 0- to 240-knot range.

d. Chart Drive Mechanism (fig. 11). The chart drive mechanism is an electromechanical assembly whose principal elements are two motors

that move the chart under the pens and rewind it after the record traces are applied.

e. Electrical Power. The RO–2/GMQ operates on a 105- to 125-volt ac, 60-cycle, single-phase power source. The RO–2A/GMQ operates on a 105- to 125-volt, ac, 50- to 65-cycle, single-phase power source.

Section II. WIND DIRECTION

37. General
(fig. 20)

The rotor of the recorder synchro B403 assumes the position dictated by the transmitter synchro. The turning of the synchro displaces, through a gear reduction, the pen and flag pointer an amount proportional to the angular movement of the synchro rotor. During the time the pen is recording wind direction in any position within limits of the chart, the pen is free to follow the corresponding position of the synchro. When the pen reaches either edge of the chart, the repositioning mechanism returns it to the approximate center of the chart and normal operation recommences. Operation and theory of the synchro system and repositioning mechanism are discussed in paragraphs 38 and 39.

38. Synchro Theory
(figs. 38 and 39)

a. Synchro Construction. The construction of a synchro motor and generator is as follows: Each synchro consists of a rotor that is free to rotate within the synchro and a stator that is stationary within the synchro case and that surrounds the rotor. The rotor contains a single-phase winding. The stator is coupled inductively to the rotor so that voltage is induced in the stator winding when the rotor is connected to a power source. The stator is a three-phase winding with three leads (S1, S2, and S3) connected to positions on the stator winding, which are 120° out of phase with respect to each other; thus, if S1 is at 0° electrically, then S2 will be at 120° and S3 will be at 240° with respect to the phase of the impressed ac voltage on the rotor. The stator windings always will be separated by a 120° phase difference although the actual phase of the induced voltages will depend on the angular position of the rotor with respect to the stator. The electrical construction of synchro motors and generators is identical. Synchro motors, however, contain mechanical dampers that prevent the rotor from excessive oscillation or rotation as an induction motor.

b. Basic Synchro System. A synchro system consists of a synchro generator and one or more synchro motors. For discussion, a system containing a synchro generator and only one motor is considered. The rotors of both synchros are connected in parallel (R1–R1, etc.) and are

connected to a 105- to 125-volt, ac, 60-cycle, single-phase power source. The stator leads of the two synchros are connected directly to each other but are not connected to any power source. All voltages on the stator leads are induced voltages. There are two possible conditions that may exist in the synchro system, *balance* condition and *unbalance* condition. These conditions are described in (1) and (2) below.

(1) *Balance condition.* As shown in *a* above, each stator lead will contain an induced voltage whose phase and magnitude is determined by the angular position of the rotor with respect to the stator. Since the electrical operation of both synchros is the same, then when both synchros are in the same position relative to their stators, the phase and magnitude of the voltages on corresponding stator leads (S1 and S1, etc.) will be equal. The equal voltages balance each other and no current flows in the stator circuits. As no current flows, no torque is produced, and the rotors remain in the balance condition.

(2) *Unbalance condition.* When an outside source moves the generator rotor from the balance condition, the phase and magnitude of the voltages impressed on the generator stator leads are changed, the stator circuits are no longer balanced, and current flows in both synchro stators. This current produces a rotating torque in both synchros. If the source that moves the generator rotor will hold it in its new position, then only the motor rotor is free to rotate. When this torque drives the motor rotor to a relative position that corresponds to the relative position of the generator rotor, then the voltages induced on the stator circuits again will balance and the torque no longer will be produced.

c. Synchro Wind Direction System. When the synchro generator is installed in a direction transmitter so that its rotor is coupled mechanically to a wind vane, the rotor will assume a position representing wind direction. The synchro motor is installed in the recorder so that its rotor is coupled mechanically, through a gear reduction, to a pen that records on a chart graduated in wind degrees. By alining the position of the recorder pen to agree with the wind vane position and by calibrating the chart so that 360° rotation of the wind vane will produce an angular displacement of the pen equal to 360° on the chart, the pen is made to represent actual wind direction.

d. Electrical Zero. The 1HG and 1F synchros are both constructed so that they will position their rotors to the same relative position when wired as shown in figure 22. By positioning the synchro generator in the transmitter so that its vane points to the geographical north when wired as shown in figure 22 and by positioning the synchro motor in the recorder so that the pen indicates north (N) on the chart when wired

as shown in figure 22, the two synchros may be considered alined, as they both are in the same position with respect to direction.

39. Repositioning

(figs. 38 and 39)

The wind vane is free to follow every variation in wind direction that may cause it to revolve in the same direction for several revolutions. Whenever the pen approaches the limit of the chart in either direction, an electromechanical circuit returns it to the 270° position of the chart and then allows it to operate normally. The operation of the repositioning circuit is as follows:

a. When the pen reaches the approximate end of the scale marked *S*, the moving contact arm of limit switch S401 makes contact with contact S thus energizing relay K402 (figs. 38 and 39). When this relay is energized, the power to all synchros in the system (transmitter, indicator, and recorder) is interrupted, thus rendering them torqueless, and repositioning motor coil L401 is energized, producing a rotating torque in the disk, thus driving the pen toward the center of the chart. The contacts of limit switch S401 open as soon as the pen starts to move toward the center of the chart; however, relay K402 stays energized by a holding circuit until the pen reaches a few degrees beyond midscale of the chart; that is until the brush of the K402 circuit no longer rides on the conducting segment of the commutator. When relay K402 is de-energized, the circuit to coil L401 of the repositioning motor is broken and power is applied to all synchros. The recorder synchro assumes the same position as the transmitter synchro, and normal operation resumes as it did before the pen reached the end of the chart. Should the pen reach the opposite full-scale position on the end of the scale marked N, operation is very similar to the above, except that the following are used: relay K401, repositioning motor coil L402 that drives the pen in the opposite direction, and the contacts of the limit switch and commutator which are in the relay K401 circuit. The setting of the N and S contacts of the limit switch does not alter the accuracy with which the pen follows the position of the synchro. The relationship of the pen to synchro is a fixed relationship brought about by the meshing of the gears. The limit switch contacts were adjusted so that the pen reversal would take place 10-wind degrees from each end of the scale. This is an arbitrary setting and could just as well be 5° or 15° or any other setting.

b. Five-second thermal-delay relay K403 protects the repositioning motor coils if they remain energized at the end of a normal repositioning cycle (*a* above). The relay is designed so that the contacts that are connected to pins 5 and 7 are normally closed. Five seconds after heater voltage is applied to pins 2 and 3, contacts 5 and 7 open. The contacts of the relay are connected in series with repositioning motor

coils L401 and L402 and the heater is connected in the circuit so that voltage is applied to it when the equipment is repositioning. When repositioning takes place, normally in 2.5 seconds or less, the heater is in the circuit but the contacts that are in series with the repositioning coils will stay closed for 5 seconds. In normal operation, the repositioning cycle will be completed and heater voltage removed from the thermal-delay relay before the contacts open. If relays K401 and K402 stay in the repositioning position more than 5 seconds, the thermal-delay relay contacts will open and power will not be supplied to the repositioning motor.

40. Inking System

The operation of the inking system in the direction system and in the speed system is the same. The pens are connected mechanically to the synchro rotor in the direction system and to the voltmeter in the speed system. The pen tube contains knife-edged pivots that rest in a bearer attached to the recording mechanism (direction or speed). The inner end of the pen tube is constructed so that it dips down into the ink tank through a small opening in the ink tank and ink is carried to the pen point by capillary attraction.

Section III. WIND SPEED

41. General
(fig. 21)

The wind speed system measures and records wind speed values supplied by a remotely exposed transmitter. The wind speed system is a recording voltmeter consisting of a D'Arsonval moving-coil voltmeter coupled directly to a pen that moves across a chart calibrated in units of wind speed. The characteristics of the values supplied by the remote transmitter and the load, ranging circuits, and signal requirements of recorder speed system are described in paragraph 42.

42. Theory

a. Signal Requirements. The wind speed mechanism measures and records wind speed values from a remote transmitter. These wind speed values must have the following characteristics:

(1) Operation into a 1,150-ohm load.
(2) Voltage linear with wind speed.
(3) 0 to 14.6 ±.01 volt dc represents 0 to 120 knots wind speed.
(4) 0 to 29.2 ±.02 volt dc represents 0 to 240 knots wind speed.

b. Ranging Circuits and Resistance Load. The internal resistance, consisting of moving coil voltmeter M402 (figs. 38 and 39) and calibrated resistor R405, has a total resistance equal to 2,300 ohms. A 2,300-ohm resistance (R403) is shunted across the circuit so that the combined resistance becomes 1,150 ohms on the 0- to 120-knot scale. (Resistor

R403 is not used when operated with an indicator.) A variation of the resistive network for the 0- to 240-knot range maintains an 1,150-ohm load to the circuit by 1,533.3-ohm shunt resistor R402 and 2,300-ohm resistor R401 in series with the voltmeter. These resistors halve the amount of current going through the meter and allow measurement of the wind speeds up to a full-scale reading of 240 knots. The speed element is calibrated so that a 120-knot indication (full scale) occurs at 14.6 ±.01 volt and a 240-knot indication (full scale) occurs at 29.2 ±.02 volt on the 0- to 120- and 0- to 240-knot scales, respectively. The operation of the pen and inking system is described in paragraph 40. When recorder dual range switch S405 is in the 0–240K position, the indicator wind speed meter is removed automatically from the circuit.

Section IV. CHART DRIVE MECHANISM

43. General

The chart drive mechanism (fig. 11) draws the chart under the pens at a predetermined constant rate of speed. This mechanism supplies a time base for the record.

44. Theory

The chart is moved by a sprocket-type drive roll (3, fig. 11) that is coupled to a motor (23) through a gear train. In the RO–2/GMQ, this motor (23, fig. 11) is a synchronous motor which requires a regulated 60-cycle ac power supply. In the RO–2A/GMQ (fig. 12), this motor is a dc type motor whose speed is constant although the voltage and frequency may vary. A power transformer (T401) and a full-wave selenium rectifier (CR401) are used to furnish dc power to the motor (fig. 39). Chart speed is determined by the selection of two gears in this gear train. After passing under the pens and over the drive roll, the chart is rewound on the chart takeup reel (10, fig. 11). This reel is driven by the takeup motor (8), which is an induction motor designed to provide constant tension during operation. Power is supplied to the takeup motor through the microswitch (takeup motor switch) (S403, fig. 13). This microswitch forms a part of the assembly that holds the takeup reel in position and is closed only when the takeup reel is inserted in the chart drive mechanism.

Section V. ELECTRICAL POWER

45. General

The RO–2/GMQ operates on a 105- to 125-volt, 60-cycle, ac power source; and the RO–2A/GMQ operates on a 105- to 125-volt, 50- to 65-cycle, ac power source. Power is introduced into the equipment through

a two-contact connector (fig. 6). The line is fused by two fuses (fig. 9). Three-position switch S404 (POWER WITH LIGHTS-OFF-POWER WITHOUT LIGHTS) (fig. 9) supplies power with lights, power without lights, or turns the equipment off. The illuminating lamps are located in the upper right and left hand corners of the case and supply light to the chart and indication scales. These lamps operate on line voltage.

46. Applying Power to Chart Drive Mechanism

Power is introduced to the chart drive mechanism through a male plug (27, fig. 37) located on the right side plate. This plug is in contact with female jack (64, fig. 31) in the housing case when the chart drive mechanism is in its normal operating position. The chart movement switch (9, fig. 35), located on the left side plate, controls power to the two motors. For the RO–2/GMQ, it is essential to supply a steady 60-cycle ac voltage to the chart drive mechanism. Variations in line frequency will cause proportional variations in the motor speed, thereby causing proportional variations in chart speed. For example, a 3-cycle variation will cause a 5 percent time error during the period of variation, or 3 minutes in 1 hour. The chart drive mechanism of the RO–2A/GMQ requires a 50- to 65-cycle voltage supply to drive the chart at constant speed.

CHAPTER 6
FIELD MAINTENANCE

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available and by the skill of the repairman.

Section I. CHECKING, STRIPPING, AND CLEANING

47. General

When the recorder is received for repair, it is not necessary to have a component of Wind Measuring Set AN/GMQ–11 available. Complete instructions for signal substitution, when appropriate, are included in paragraphs 48 through 76. Repairmen should familiarize themselves with the operating procedures in paragraphs 16 through 21 and the maintenance instructions in paragraphs 48 through 76.

48. Tools and Test Equipment Required for Field Maintenance

The following tools, test equipments, and materials are required in performing field maintenance on this equipment.

Tool Equipment TE–113
Multimeter TS–352/U
Synchro (type 1HG, 1F, or 1G) of known accuracy
Dc voltage source, 0–36 v } 3 ea (or 6 ea, if required) dry cell batteries
Solvent (SD)
Sandpaper No. 6/0
Lint-free cloth
Variable resistor (potentiometer) (500–ohm ± 10%—50 watts)

49. Checking for Faults

Make the following checks to sectionalize faults in the equipment. Refer to paragraphs 53 and 54.

a. Wind Direction Mechanism.

(1) Connect an external synchro with a pointer (fig. 23) that indicates azimuth on an 8-inch dial graduated every 15°. Provision must be made so that the dial can be set relative to the synchro.

(2) Turn power and lights switch S404 to the POWER WITH LIGHTS position.

(3) With the pen producing a trace and the chart moving at a rate of 3 or 6 inches per hour, move the external pointer clockwise until the recorder pen coincides with the 30° graduation on the left side of the chart.

(4) Turn the azimuth dial, relative to the external synchro, until the pointer coincides with a 15° graduation.

(5) Secure the dial so that it will not move relative to the synchro.

(6) Move the pointer in a counterclockwise (to the left) direction approximately 15°, then in a clockwise (to the right) direction until the pointer coincides with the original graduation.

(7) Check to see that the pen is indicating 30; if not, again shift the azimuth dial until the pen indicates 30 and the pointer coincides with the graduation.

(8) After establishing the starting point, move the pointer in a clockwise direction; note the recorded value every 30° for 480 circular degrees; that is, until the pen reaches the 150° line on the right side of the chart.

(9) Move the pointer 60 circular degrees, which should cause the pen to reverse direction and be repositioned to the 210° line of the chart.

(10) Repeat the above test with the following exceptions: start with the 150° line on the right side of the chart and turn the pointer in a counterclockwise direction.

(11) If the test dial values and recorded values do not differ by more than 4 geometric degrees, the wind direction mechanism is performing satisfactorily.

Note. When performing this test, the test synchro pointer should not be allowed to pass the graduation until the recorded value is noted. If the pointer is moved past the graduation, move the pointer backwards over the graduation a few degrees and again approach the graduation.

(12) Turn power and lights switch S404 to the OFF position.

b. Wind Speed Mechanism.

(1) Check the wind speed section, using the three or six 6-volt dry cell batteries for the external dc voltage. Use Multimeter TS–352/U and potentiometer (par. 48) for testing.

(2) Connect power cable (fig. 6) to the ac power source.

(3) With the speed pen producing a trace and the chart movement operating at 3 or 6 inches per hour, apply measured voltages across the G and F terminals of J403 (fig. 23) in accordance with chart below. Figure 24 is a graph showing applied voltage versus recorded wind speed for applied voltage values other than those shown on the chart below.

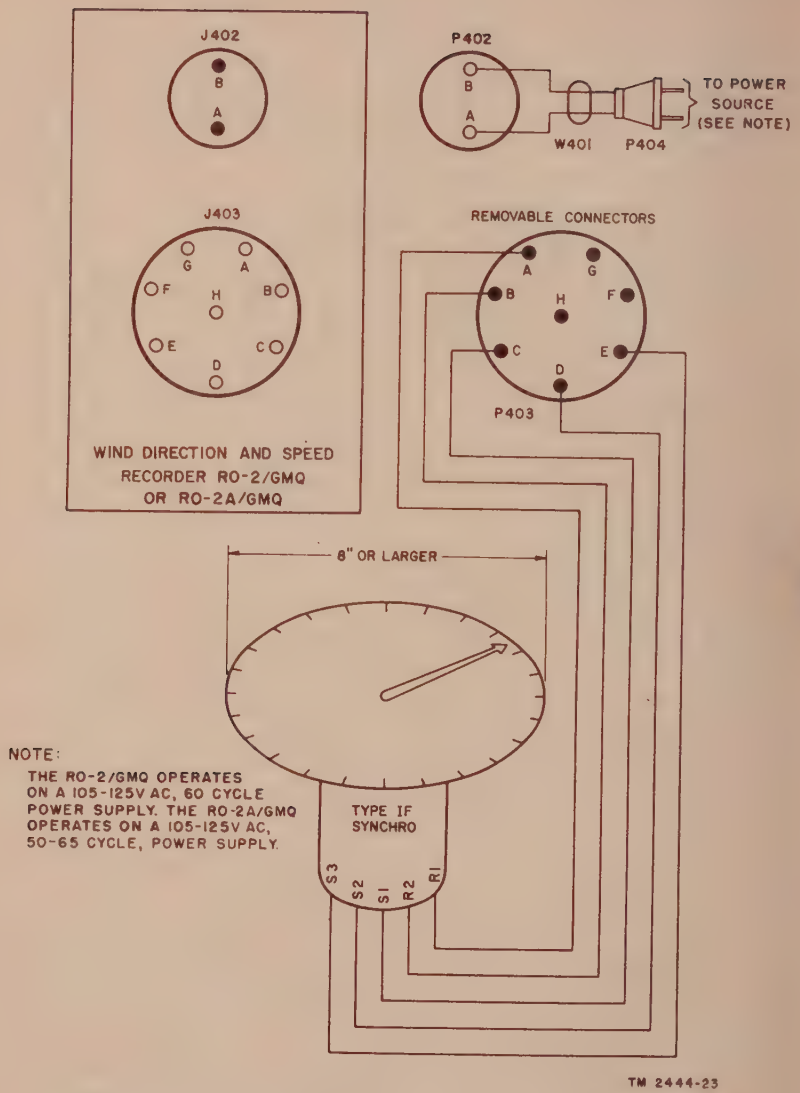


Figure 23. Electrical connection for testing direction mechanism.

(4) When performing this test, the run must be made up the scale and then down the scale.

(5) Be careful to change the voltage gradually so that the pen does not overshoot the test points.

(6) If the recorded wind speed is within 1.2 knots on the 0- to 120-knot scale and 2.4 knots on the 0- to 240-knot scale, the wind speed component is performing satisfactorily.

Dual range switch position	Voltage (dc) applied across G & F of J403 (fig. 23)	Recorded wind speed	Tolerance
0–120K	1.22	10	1.2 knots
	4.86	40	
	9.73	80	
	14.59	120	
	9.73	80	
	4.86	40	
	1.22	10	
0–240K	2.43	20	2.4 knots
	9.73	80	
	19.46	160	
	29.18	240	
	19.46	160	
	9.73	80	
	2.43	20	

c. Chart Drive Movement Test (RO–2–GMQ). With the chart and the 3-inch per hour gears installed (par. 17*a*), and the chart movement in its normal operating position, apply 105 volts ac, 60 cycles to the power cable. Allow the chart movement to operate for at least 1 day (8 hours). Examine the record to see whether the recorder has kept time within 1 minute and that the chart has been wound up on the takeup reel. It is essential that the line frequency for this test be exactly 60 cycles per second.

d. Chart Drive Movement Test (RO–2A/GMQ). With the chart and the 3-inch per hour gears installed (par. 17*a*) and with the chart movement in its normal operating position, connect the power cable to 105-125-volt ac, 60-cycle power source. Allow the chart movement to operate 1 day (8 hours). Check the record on the chart against a synchronous clock. The record should show that the recorder has kept time within 7 minutes. The chart should also be wound up on the takeup reel.

50. Stripping

The chart drive mechanism, pens, ink tanks, lamps, and fuses all may be removed easily.

a. To remove the ink tanks raise the scale plate (fig. 10), lift out the pens, and take out the ink tank by lifting with the two handles and pulling the well forward.

b. Remove the chart drive mechanism by lifting the operating levers (fig. 13), tilting the mechanism forward (fig. 2), releasing the mechanism release catch (fig. 9), and lifting out the mechanism.

c. Remove the lamps by pushing them in, twisting them, and pulling them out.

d. Remove the fuses by pulling them out of the spring clips.

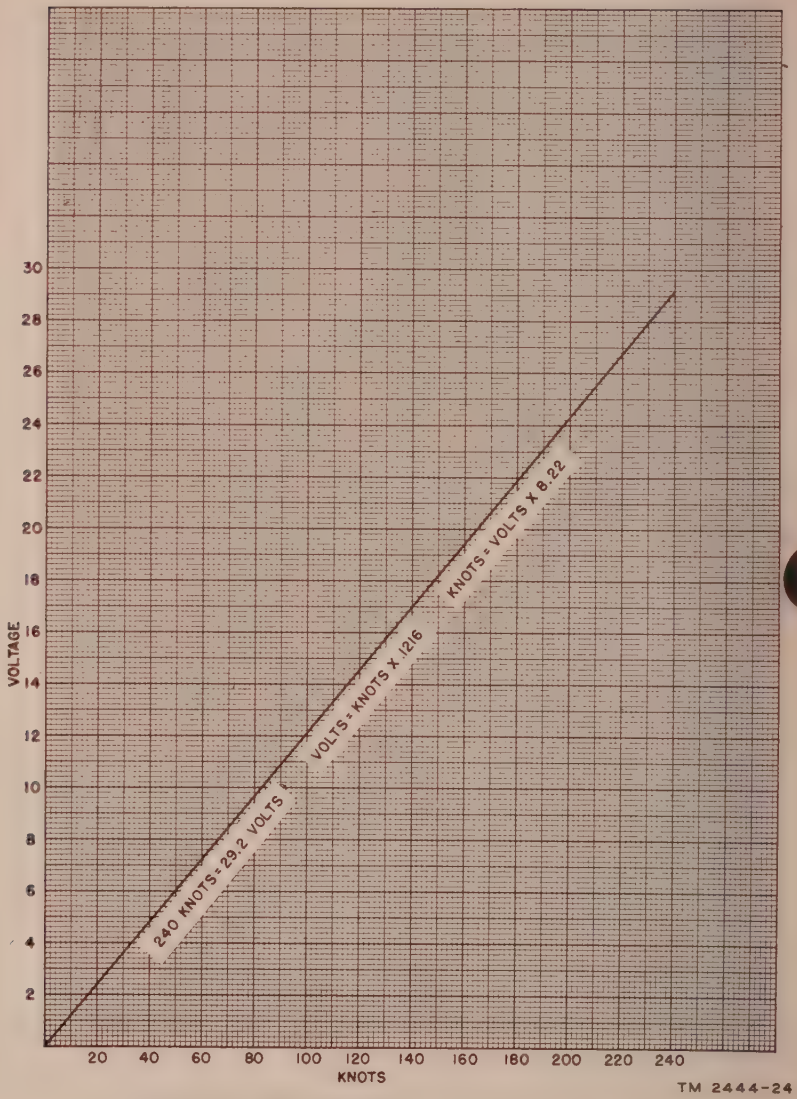


Figure 24. Graph, voltage versus wind speed indication.

51. Cleaning

Clean thoroughly all removed parts before reassembly (par. 69). Cleaning and general servicing for the ink tanks and pens are described in paragraph 24*c*. Replace the fuses or lamps if the contacts are corroded.

Note. Do not clean the chart drive mechanism unless it is disassembled in accordance with the instructions in paragraph 63.

Section II. TROUBLESHOOTING AT FIELD MAINTENANCE LEVEL

52. Tools and Equipment Required for Troubleshooting

Tool Equipment TE–113 and Multimeter TS–352/U are required for troubleshooting at field maintenance level. Paragraph 48 lists other equipment necessary when making checks.

53. Troubleshooting Procedure

The first step in servicing a defective recorder is to sectionalize the fault by performing the tests outlined in paragraph 49. The second step is to determine which part is defective. The troubleshooting charts in paragraph 54 show, in tabular form, the trouble shown by the test in paragraph 49, the probable cause of the trouble, and the recomended remedy or remedies.

54. Troubleshooting Charts

Before proceeding with routine troubleshooting, be sure that power is supplied to the equipment and that the fuses are not blown.

a. Power and Lights.

Symptom	Probable trouble	Correction
No lights	Supply plug open or disconnected.	Repair or replace.
	Power and lights swith S404 at OFF position (fig. 9).	Turn to on position.
	Fuses blown (F401, F402) (fig. 9).	Replace* (par. 50*d*).
	Power and lights switch S404 open (fig. 9).	Repair or replace (par. 73*g*(3)).
	Lamps burned out (32, fig. 27).	Replace (par. 50*c*).
	No power	Check power cable, fuses and wiring.

*If, after replacing a blown fuse, the replaced fuse blows, a visual inspection for shorts or improper test connections should be made and then a resistance check (par. 71) should be made. The resistance of all terminals to ground should be in excess of 200,000 ohms.

b. Wind Direction System.

Symptom	Probable trouble	Correction
No pen movement.	No power	Check main power supply at terminals of J402.
	Shorted or open synchro windings (43, fig. 28).	Replace synchro (43, fig. 28).
	Rotor of synchro not free to rotate due to excessive friction.	Replace synchro (43, fig. 28).
	No voltage to synchro.	Replace thermal-delay relay (1, fig. 28).
Movement of pen in opposite direction.	Synchro stator leads not properly connected.	Wire according to schematic (figs. 38 and 39) and wiring diagrams (figs. 7 and 8).

Symptom	Probable trouble	Correction
Back and forth movement of pen through only a portion of the chart.	One of the synchro stator circuits open.	Replace synchro (43, fig. 28).
False indications	Synchro rotor not free to rotate due to excessive friction.	Replace synchro (43, fig. 28).
	Pen not properly adjusted	Adjust pen (par. 34*a*).
	Open or shorted rotor circuit	Check A and B leads of J403 (fig. 8).
Overheating synchro.	Rotor not free to rotate	Replace synchro (43, fig. 28).
	Rotor windings shorted or stator windings open or shorted.	Replace synchro (43, fig. 28).
Indications 180° from correct position.	Reversed polarity in rotor circuits.	Wire according to schematic (figs. 38 and 39) and wiring diagram (figs. 7 and 8).
Pen fails to reverse or chatters at ends of chart.	Defective limit switch contacts (S401) (3, 6, and 7, fig. 21).	Clean with crocus paper or #6/0 sandpaper. If badly burned or pitted, replace.
	Defective relay contacts (K401 or K402) (4 and 5, fig. 21).	Clean with crocus paper or #6/0 sandpaper. If badly burned or pitted, replace.
	Defective relay coil (K401 or K402).	Check resistance (par. 71). Replace, if defective (68 and 71, fig. 28).
	Defective slipring or commutator.	Clean with crocus paper or #6/0 sandpaper. If badly burned or pitted, replace.
	Defective thermal-delay relay (K403).	Replace relay (1, fig. 28).
Pen fails to produce a satisfactory trace.	Dirty ink system	Clean and refill (par. 25).
	Pen pressure too light	Refer to paragraph 73*k*.
Pen throws ink	Pen pressure too light	Refer to paragraph 73*k*.

c. Wind Speed System.

Symptom	Probable trouble	Correction
No pen movement.	Open or shorted internal voltmeter circuit.	Check resistance (par. 71). Replace, if defective (9, fig. 29) (par. 73*i*).
Irregular movement of pen.	Loose connections	See that connections are clean and tight.
	Damaged or dirty jewels and pivots in voltmeter mechanism.	Replace mechanism (par. 73*i*).

Symptom	Probable trouble	Correction
False indication	Friction in voltmeter	Replace mechanism (9, fig. 29) (par. 73*i*).
	Incorrect pen adjustment	Adjust pen (par. 34).
	Defective voltmeter, other than friction.	Check internal resistance of meter (par. 70). Replace, if defective (9, fig. 29).
	Defective resistor R401, R402, R403, or R405.	Check resistor (par. 71). Replace, if defective.
	Dirty connections	Clean connections (par. 69*a*).
Slow response of pen.	Pen pressure too heavy	Rebalance the pen. Refer to paragraph 73*k*.
Pen fails to produce a satisfactory trace.	Dirty ink system	Clean and refill (par. 25).
	Pen pressure too light	Rebalance the pen (par. 73*k*).
Pen throws ink	Pen pressure too light	Refer to paragraph 73*k*.

d. Chart Drive Mechanism.

Symptom	Probable trouble	Correction
Chart fails to take up properly.	Defective switch (11, fig. 37).	Replace (par. 73*b*(7)).
	Defective plug P401 (27, fig. 37).	Replace (par. 73*b*(1)).
	Defective takeup motor (6, fig. 37).	Check resistance (par. 71). Replace motor, if defective (par. 73*b*(8)).
	Damaged gear teeth on takeup motor gear or takeup reel gear.	Replace (par. 73*b*(8)).
	Defective chart drive master switch (9, fig. 35).	Replace (par. 73*c*(6)).
Chart fails to feed properly (RO–2/GMQ).	Defective chart drive motor (5, fig. 35).	Check resistance (par. 71). Replace, if defective (par. 73*c*(7)).
	Defective chart movement switch S402 (9, fig. 35).	Replace (par. 73*c*(6)).
	Defective plug P401 (27, fig. 37).	Replace (par. 73*b*(1)).
Chart fails to feed properly (RO–2A/GMQ).	Defective chart drive motor (fig. 12).	If motor does not *tick*, replace it (par. 73*b*(7)).
	Defective chart movement switch S402 (9, fig. 36).	Replace (par. 73*c*(6)).
	Defective plug P401 (27, fig. 37).	Replace (par. 73*b*(1)).
	Defective transformer T401 (fig. 12).	Check input and output (fig. 39). Check resistance (par. 71). Replace if defective (par. 73*d*(7)).
	Defective rectifier CR401 (fig. 36).	Check input and output (fig. 39). Replace if defective (par. 73*d*(8)).

Section III. REPAIRS

55. Disassembly of Equipment

Complete instructions for the disassembly of the equipment are contained in paragraphs 56 through 67. Reference symbols for each part are included in the referenced figures. Troubleshooting should localize the defect to a particular malfunctioning part, thereby eliminating the necessity for disassembling the equipment completely for repairs.

56. Removal of Door and Cables
(fig. 25)

To disassemble the door and cables, proceed as follows:

a. Remove the power cable assembly (1) and connector (2).

b. Unscrew the cable clamp (3) from the connector (2).

c. Unscrew the two set screws (4), freeing the hinge pins (5), washers (6), and door assembly (7) from the case (8).

d. To disassemble the power cable assembly (1), loosen the clamp on the plug (12) and unsolder the cable (11). Unscrew the cable clamp (10) and unsolder the wires from the plug (9).

Caution: Follow instructions for tagging terminals when removing leads. Terminals are not tagged when polarity is not critical or where terminal markers are installed. *Wire number* refers to the black number stamped on the wire (figs. 38 and 39).

57. Disassembly of Door Assembly
(fig. 26)

To disassemble the door assembly, proceed as follows:

a. Unscrew the two set screws (1), freeing the latch (2), washer (3), and handle (4).

b. Unscrew the four screws (5) and lockwashers (6), and remove the nameplate (7).

c. Unscrew the four screws (8) and lockwashers (21), and remove the caution notice plate (9).

d. Remove the screws (10) and lockwashers (11), freeing the retainers (12 and 13), the shields (14 and 15), the window (16), and the gaskets (17 and 18) from the door frame (20).

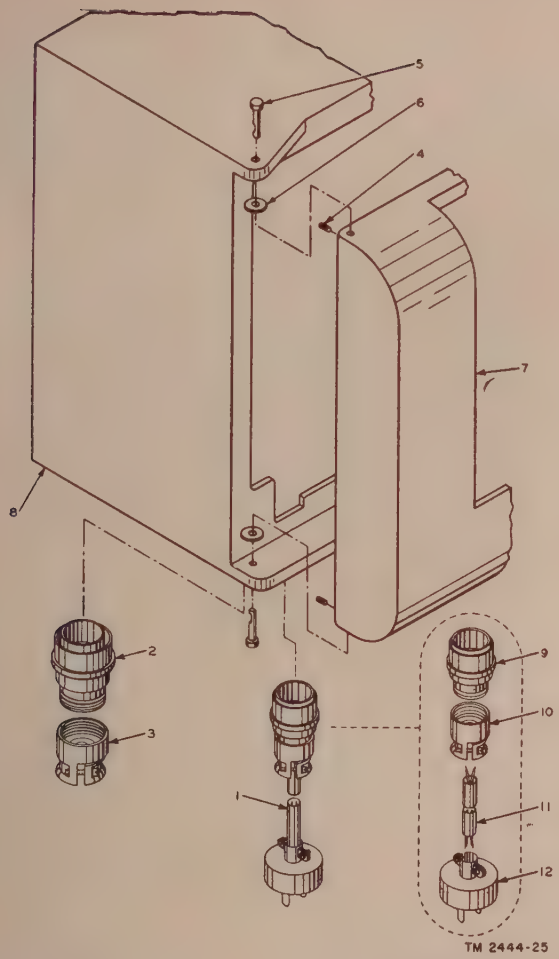
e. Remove the door gasket (19) for replacement only.

58. Removal of Major Components
(fig. 27)

To remove the major components of the recorder, proceed as follows:

a. Remove the direction pen (5) and speed pen (6). If necessary, remove the pen point (7) (par. 72*k*).

b. Unsolder the leads to the lamp sockets (31). Remove the lamps (32). Remove the four screws (1), freeing the nuts (2), lockwashers (3), and the chart guide-pen lift mechanism (4).



1 Power cable assembly (W401).
2 Connector (P403).
3 Clamp (E403).
4 Set screw (H1489).
5 Hinge pin (A 435).
6 Washer (H1487).
7 Door assembly (A 426).
8 Case assembly (A 418).
9 Connector (P402).
10 Clamp (E404).
11 Cable (W402).
12 Plug (P404).

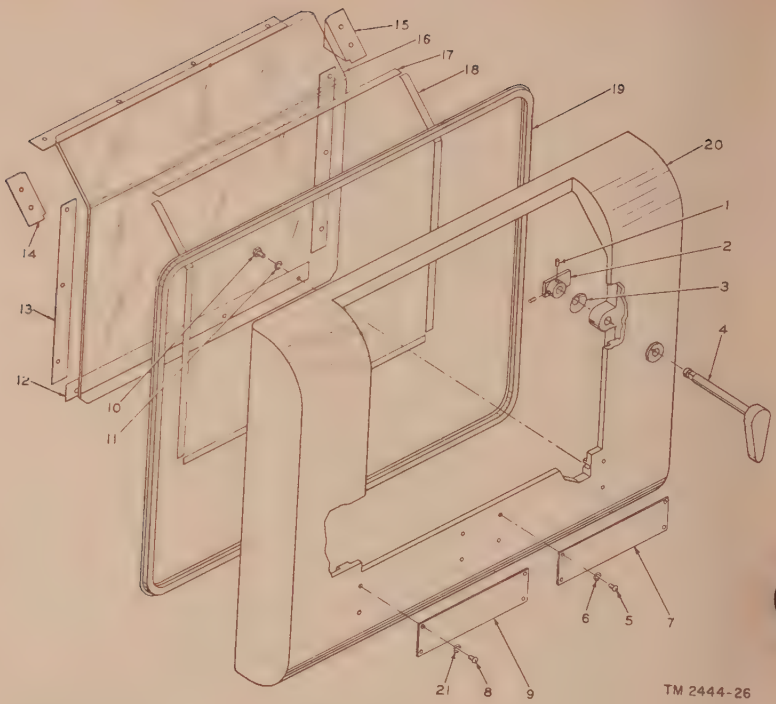
Figure 25. Recorder assembly, door and cable removal.

c. Unscrew the thumbscrew (8).

d. Unscrew the two screws (9) and free the lockwashers (10) and adjustment scale plate (11).

e. Unscrew the screw (12) and free the lockwasher (13), nut (14), and lever assembly (15).

f. Remove all leads from the left side of terminal board TB401 (fig. 38). Unscrew the three screws (16) and free the lockwashers (17) and the direction mechanism assembly (18).



1	Set screw (H1705).	8	Screw (H1707).	15	Shield (A 468).
2	Latch (A 472).	9	Caution plate (N411).	16	Window (A 477).
3	Washer (O 454).	10	Screw (H1669).	17	Gasket (A 467).
4	Handle (A 478).	11	Lockwasher (H1687).	18	Gasket (A 475).
5	Screw (H1459).	12	Retainer (A 474).	19	Gasket (A 469).
6	Lockwasher (H1455).	13	Retainer (A 471).	20	Door frame (A 473).
7	Name plate (N405).	14	Shield (A 470).	21	Lockwasher.

Figure 26. Door assembly, exploded view.

g. Unscrew the thumbscrew (19).

h. Unscrew the two screws (20) and free the lockwashers (21) and the adjustment scale plate (22).

i. Remove the lever (23) by pulling it free.

j. Remove the two screws (33, fig. 31) and free the lockwashers (34), protective cover (35), and spacers (36). Remove the red and black leads from terminal board TB402 (fig. 38).

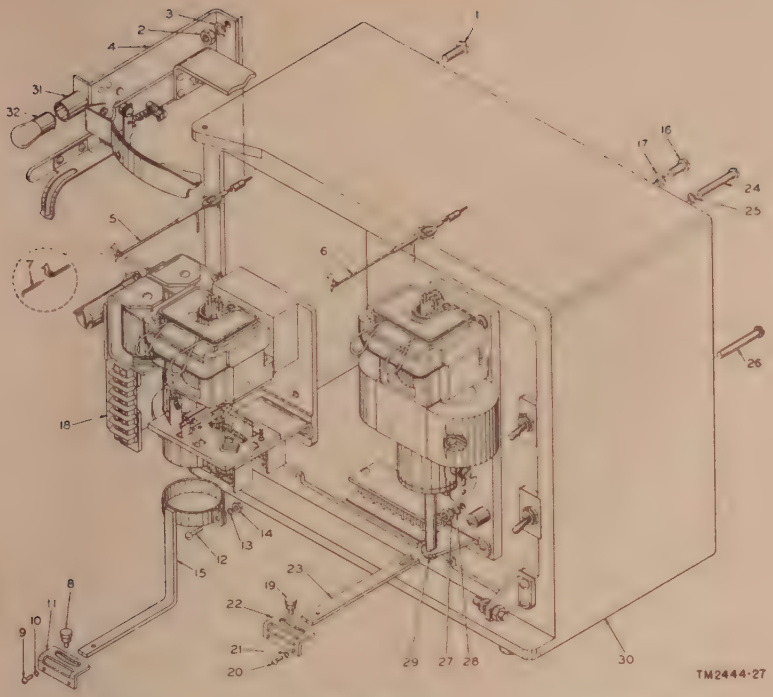
k. Unscrew the screw (26, fig. 27), freeing the lockwashers (28), and nut (27). Unscrew the two screws (24), freeing the lockwashers (25) and speed mechanism assembly (29) from the case assembly (30).

59. Disassembly of Wind Direction Mechanism (fig. 28)

To disassemble the wind direction mechanism, proceed as follows:

a. Disengage the retainer (5) and pull out the relay (1).

b. Unsolder the wires from the rear of the socket (4). Unscrew the



1	Screw (H1417).	12	Screw (H1510).	23	Adjustment lever (A 443).
2	Nut (H1421).	13	Lockwasher (H1512).	24	Screw (H1407).
3	Lockwasher (H1425).	14	Nut.	25	Lockwasher (H1405).
4	Chart guide-pen lift mechanism (A 419).	15	Lever assembly (A 427).	26	Screw (H1551).
5	Direction pen (A 420).	16	Screw (H1432).	27	Nut (H1552).
6	Speed pen (A 421).	17	Lockwasher (H1429).	28	Lockwasher (H1553).
7	Pen point (part of A 420).	18	Direction mechanism assembly (A 425).	29	Speed mechanism assembly (M401).
8	Thumbscrew (O 427).	19	Thumbscrew (O 428).	30	Case assembly (A 418).
9	Screw (H1499).	20	Screw (H1501).	31	Lamp socket (X401).
10	Lockwasher (H1503).	21	Lockwasher (H1505).	32	Lamp (I 401).
11	Scale (N408).	22	Scale (N408).		

Figure 27. Removal of major mechanisms.

two screws (2), freeing the lockwashers (3), socket (4) retainer (5), and nuts (6).

c. Unsolder the wires from the coil assembly (12). Unscrew the two screws (7), freeing the lockwashers (8), bracket (75), and motor coil (12).

d. Unsolder the wires from the coil assembly (11). Unscrew the two screws (9), freeing the lockwashers (10) and motor coil (11).

e. Remove the wires from the terminal board (15). Unscrew the four screws (13), freeing the lockwashers (14), terminal board (15), and terminal marker (16).

f. Unscrew the screw (18) and two screws (19), freeing the lockwashers (17 and 20) and bracket (21).

g. Unsolder the wires from the coils (26 and 32). Unscrew the two

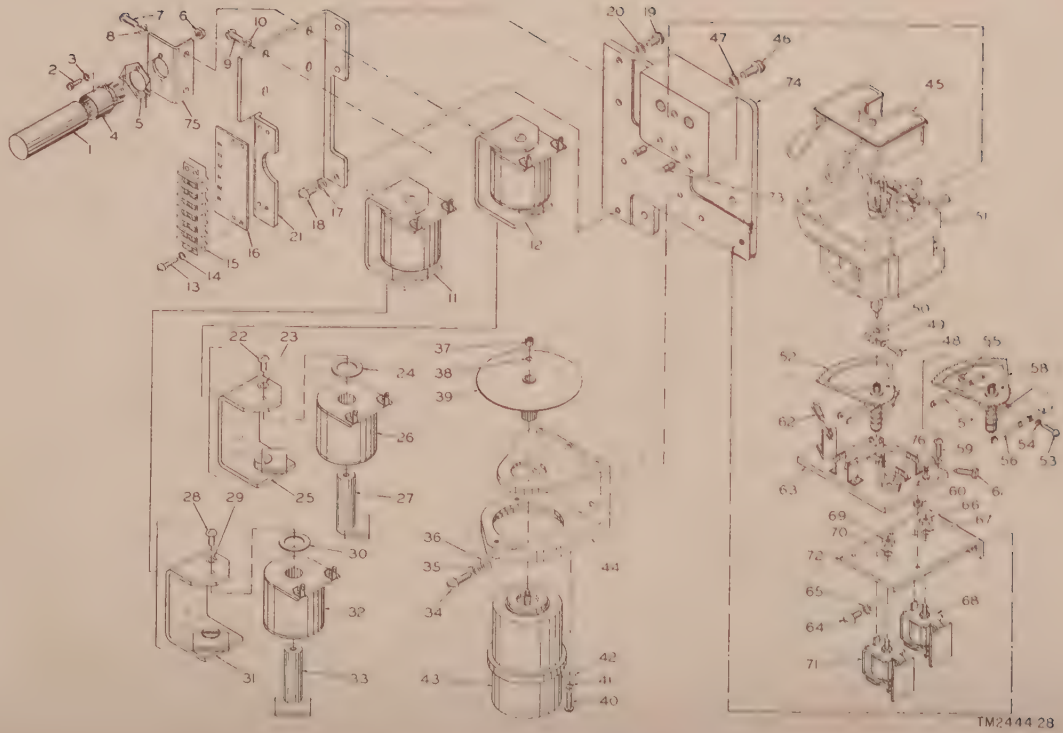


Figure 28. Wind direction mechanism, exploded view.

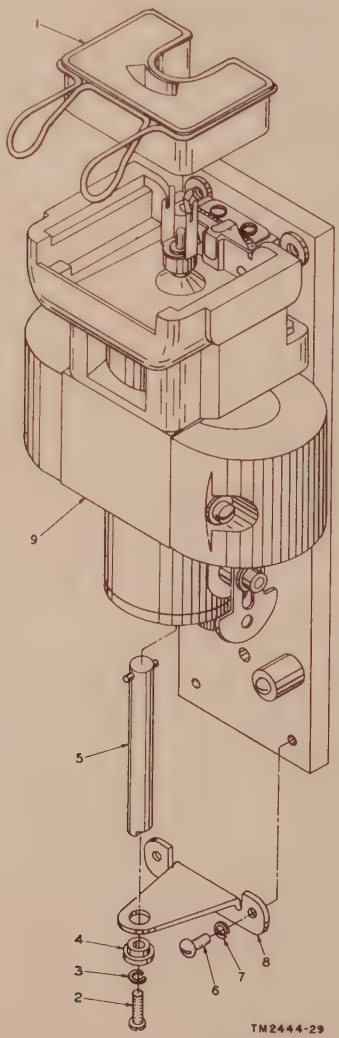
1 Thermal delay relay (K403).
2 Screw (H1616).
3 Lockwasher (H1612).
4 Socket (XK403).
5 Retainer (O 445).
6 Nut (H1614).
7 Screw (H1723).
8 Lckwasher (H1599).
9 Screw (H1597).
10 Lockwasher (H1599).
11 Coil assembly (E411).
12 Coil assembly (E412).
13 Screw (H1640).
14 Lockwasher (H1636).
15 Terminal board (TB401).
16 Terminal marker (N410).
17 Lockwasher (H1645).
18 Screw (H1644).
19 Screw (H1601).
20 Lockwasher (H1603).
21 Bracket (A 462).
22 Screw (H1721).
23 Lockwasher (H1719).
24 Spacer (O 455).
25 Bracket (A 482).
26 Coil (L401).
27 Core (E413).
28 Screw (H1722).
29 Lockwasher (H1720).
30 Spacer (O 456).
31 Bracket (A 481).
32 Coil (L402).
33 Core (E414).
34 Screw (H1622).
35 Lockwasher (H1620).
36 Washer (H1618).
37 Nut (O 446).
38 Lockwasher (H1605).
39 Pinion and disk assembly (O 448).
40 Screw (H1649).
41 Lockwasher (H1652).
42 Washer (H1646).
43 Synchro (B403).
44 Synchro housing (A 461).
45 Ink tank (A 460).
46 Screw (H1665).
47 Lockwasher (H1667).
48 Screw (H1655).
49 Lockwasher (H1656).
50 Clamping block (O 447).
51 Top movement assembly (A 464).
52 Contact and sector assembly (E408).
53 Screw (H1711).
54 Lockwasher (H1715).
55 Nut (H1713).
56 Contact arm (E409).
57 Contact arm (E410).
58 Sector assembly (part of E408).
59 Screw (H1606).
60 Spacer (O 449).
61 Contact screw (E405).
62 Contact screw (E406).
63 Contact plate assembly (E407).
64 Screw (H1661).
65 Lockwasher (H1663).
66 Nut (H1657).
67 Lockwasher (H1659).
68 Relay (K402).
69 Nut (H1658).
70 Lockwasher (H1660).
71 Relay (K401).
72 Relay bracket (A 465).
73 Dowel pin (O 452).
74 Housing (A 463).
75 Relay bracket (A 459).
76 Lockwasher

Figure 28—Continued.

screws (22 and 28), freeing the lockwashers (23 and 29), spacers (24 and 30), cores (27 and 33), coils (26 and 32), and brackets (25 and 31).

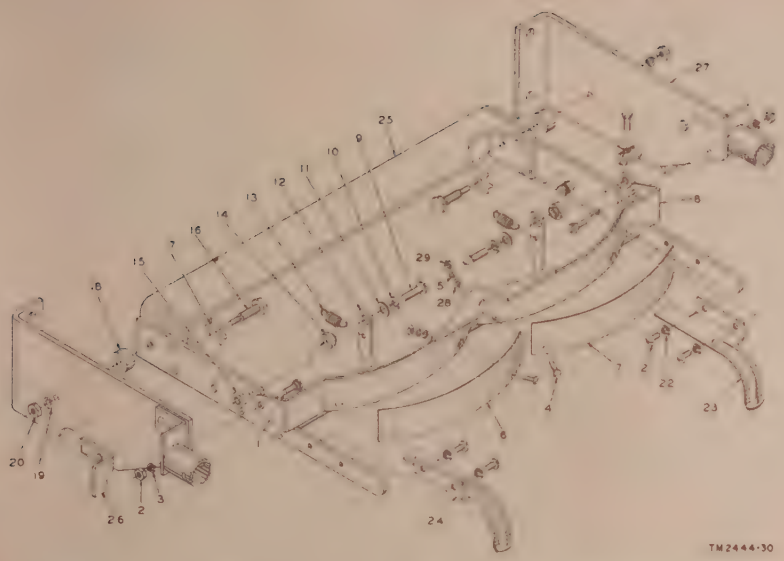
h. Remove the leads from the bottom of the synchro (43). Unscrew the two screws (34), freeing the lockwashers (35), washers (36), and synchro housing assembly (44).

i. Unscrew the nut (37), freeing the lockwasher (38) and the pinion and disk assembly (39).



1 Ink tank (part of M401).
2 Screw (H1453).
3 Lockwasher (H1454).
4 Spacer (O 432).
5 Shaft (O 431).
6 Screw (H1554).
7 Lockwasher (H1556).
8 Bracket (A 444).
9 Voltmeter (M402).

Figure 29. Wind speed mechanism, exploded view.



1	Shoulder screw (O 439).	12	Latch (A 457).	23	Right chart guide (A 456).
2	Nut (H1583).	13	Spring (O 443).	24	Left chart guide (A 454).
3	Lockwashers (H1585).	14	Spacer (O 437).	25	Lever assembly (A 452).
4	Screw (H1413).	15	Nut (H1573).	26	Left bracket assembly (A 451).
5	Lockwasher (H1409).	16	Pivot studs (O 433).	27	Right bracket assembly (A 453).
6	Direction scale (N401).	17	Spring washer (H1577).	28	Washer.
7	Speed scale (N402).	18	Spacer (O 435).	29	Nut.
8	Scale holder (A 465).	19	Lockwasher (H1581).		
9	Screw (H1575).	20	Nut (H1579).		
10	Lockwasher (H1569).	21	Screw (H1587).		
11	Washer (H1571).	22	Lockwasher (H1591).		

Figure 30. Chart guide-pen lift mechanism, exploded view.

j. Unscrew the three screws (40), freeing the lockwashers (41), washers (42), and the synchro (43) from the housing (44).

k. Lift the ink tank (45) from the top movement assembly (51).

l. Unscrew the two screws (64), freeing the lockwasher (65) and bracket (72).

m. Remove the two contact screws (62 and 61).

n. Tag each terminal on the contact plate assembly (63) with the wire number of the attached wire. Unsolder the wires. Unscrew the three screws (59), freeing the spacers (60), lockwashers (76), and contact plate assembly (63).

o. Tag each terminal of the relays (68 and 71) with the wire number of the attached wire. Unsolder the wires. Unscrew the two nuts (66 and 69), freeing the lockwashers (67 and 70) and relays (68 and 71).

p. Unsolder the wires from the contact arms (56 and 57). Unscrew the screw (48), freeing the lockwasher (49) and loosening clamping block (50) so that the contact and sector assembly (52) is free.

q. Unscrew the two screws (53) freeing the lockwashers (54), nuts (55), and contact arms (56 and 57) from the sector assembly (58).

r. Unscrew the two screws (46), freeing the lockwashers (47) and top movement assembly (51).

s. Remove the dowel pins (73) from the housing (74).

60. Disassembly of Wind Speed Unit Assembly (fig. 29

To disassemble the wind speed unit assembly, proceed as follows:

a. Lift out the ink tank (1).

b. Remove the screw (2), lockwasher (3), and spacer (4) from the shaft (5).

c. Unscrew the two screws (6) and lockwashers (7), and remove the bracket (8) from the voltmeter (9).

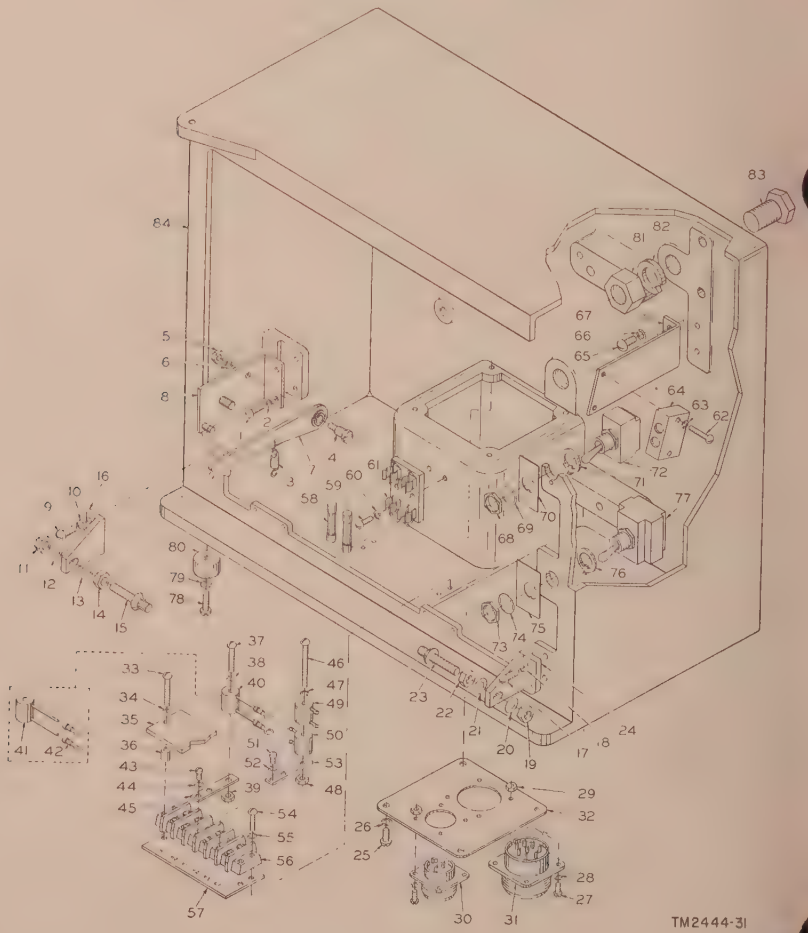


Figure 31. Case assembly, exploded view.

61. Disassembly of Chart Guide-Pen Lift Mechanism
(fig. 30)

To disassemble the chart guide-pen mechanism, proceed as follows:

a. Unscrew the two shoulder screws (1), freeing the two nuts (2), lockwashers (3), and scale holder (8).

b. Remove the direction and speed scales (6 and 7) from the scale holder (8) by removing the four screws (4), lockwashers (5), washers (28), and nuts (29).

c. Remove the two screws (9), lockwashers (10), washers (11), latches (12), springs (13), spacers (14), and nuts (15).

d. Remove the two pivot studs (16), spring washers (17), spacers (18), lockwashers (19), and nuts (20), freeing the lever assembly (25) from the right and left bracket assemblies (27 and 26).

e. Remove the four screws (21) and lockwashers (22), freeing the right and left chart guides (23 and 24).

62. Disassembly of Case Assembly
(fig. 31)

To disassemble the case assembly, proceed as follows:

a. Remove the spring (3) from the latch (7). Unscrew the two screws (1), freeing the lockwashers (2) and bracket (8). Remove the shoulder screw (4), freeing the nut (5), lockwashers (6), and latch (7).

b. Unscrew the two screws (9), freeing the lockwashers (10) and left hand bracket (16). Remove the nut (11), washers (12 and 13), nut (14), and pivot stud (15).

c. Unscrew the two screws (17), freeing the lockwashers (18) and

1 Screw (H1401).
2 Lockwasher (H1403).
3 Spring (O 426).
4 Shoulder screw (A 417).
5 Nut (H1436).
6 Lockwasher (H1435).
7 Latch (A 415).
8 Bracket (A 416).
9 Screw (H1441).
10 Lockwasher (H1437).
11 Nut (H1491).
12 Washer (H1495).
13 Washer (H1496).
14 Nut (H1492).
15 Pivot stud (O 429).
16 Bracket, left hand (A 428).
17 Screw (H1443).
18 Lockwasher (H1439).
19 Nut (H1493).
20 Washer (H1497).
21 Washer (H1498).
22 Nut (H1494).
23 Pivot stud (O 430).
24 Bracket, right-hand (A 432).
25 Screw (H1529).
26 Lockwasher (H1533).
27 Screw (H1468).
28 Lockwasher (H1479).
29 Nut (H1471).
30 Receptacle (J402).
31 Receptacle (J403).
32 Plate (A 434).
33 Screw (H1539).
34 Lockwasher (H1543).
35 Protective cover (O 457).
36 Spacer (A 483).
37 Screw (H1508).
38 Lockwasher (H1509).
39 Nut (H1507).
40 Resistor assembly (R403).
41 Resistor (R404).
42 Terminals (E415).
43 Screw (part of TB402).
44 Lockwasher (H1513).
45 Mounting plate (A 438).
46 Screw (H1566).
47 Lockwasher (H1567).
48 Nut (H1568).
49 Resistor (R401).
50 Resistor (R402).
51 Screw (part of TB402).
52 Lockwasher (H1514).
53 Mounting plate (A 450).
54 Screw (H1537).
55 Lockwasher (H1541).
56 Terminal board (TB402).
57 Terminal marker (N407).
58 Fuse (F401).
59 Screw (H1525).
60 Lockwasher (H1527).
61 Fuse mounting (A 437).
62 Screw (H1445).
63 Lockwasher (H1447).
64 Jack (J401).
65 Screw (H1449).
66 Lockwasher (H1451).
67 Bracket (A 429).
68 Locknut (part of S405).
69 Washer (part of S405).
70 Identification plate (N403).
71 Locking ring (A 430).
72 Switch (S405).
73 Locknut (part of S404).
74 Washer (part of S404).
75 Identification plate (N404).
76 Locking ring (A 431).
77 Switch (S404).
78 Screw (H1558).
79 Lockwasher (H1562).
80 Foot (A 439).
81 Nut (H1545).
82 Lockwasher (H1548).
83 Mounting stud (A 422).
84 Case (A 418).

Figure 31—Continued.

right hand bracket (24). Remove the nut (19), washers (20 and 21) nut (22), and pivot stud (23).

d. Unsolder the wires from receptacles (30 and 31). Remove the four screws (25) and lockwashers (26), freeing the receptacle mounting plate (32). Remove the eight screws (27), freeing the lockwashers (28), nuts (29), and receptacles (30 and 31).

e. Remove the screw (37), freeing the lockwasher (38), nut (39), and resistor assembly (40). Unsolder the terminals (42) from the resistor (41) if terminals need replacing.

f. Unscrew the two screws (43), freeing the lockwashers (44) and mounting plate (45).

g. Tag the terminals of the resistors (49 and 50) with the wire numbers of the attached wires. Unsolder the wires. Unscrew the screw (46), freeing the lockwasher (47), nut (48), and resistors (49 and 50).

h. Remove the two screws (51), freeing the lockwashers (52) and mounting plate (53).

i. Remove the wires from the terminal board (56). Unscrew the two screws (54), freeing the lockwashers (55), terminal board (56), and terminal marker (57).

j. Tag each terminal on the fuse mounting (61) with the wire number of the attached wire. Unsolder the wires. Remove the two fuses (58). Unscrew the two screws (59), freeing the lockwashers (60) and the fuse mounting (61).

k. Unsolder the leads from jack (64). Unscrew the two screws (62), freeing the lockwashers (63) and jack (64). Unscrew the two screws (65), freeing the lockwashers (66) and bracket (67).

l. Tag each terminal on the switch (72) with the wire number of the attached wire. Unsolder the wires. Remove the locknut (68), freeing the washer (69), identification plate (70), locking ring (71), and switch (72).

m. Tag each terminal on the switch (77) with the wire number of the attached wire. Unsolder the wires. Unscrew the locknut (73), freeing the washer (74), identification plate (75), locking ring (76), and switch (77).

n. Unscrew the four screws (78), freeing the lockwashers (79) and mounting feet (80).

o. Unscrew the three nuts (81), freeing the lockwashers (82). Unscrew the mounting studs (83) from the case (84).

63. Disassembly of the Chart Drive Mechanism
(fig. 32 or 33)

To disassemble the chart drive mechanism, proceed as follows:

a. Unscrew the nut (1), and remove the gear (2).

b. Unscrew the two set screws (3), and remove the set knob (4).

c. Remove the four set screws (5), and pull out two shafts (6 and 7), freeing the drive roll (8).

d. Remove the four screws (9), freeing the bracket (10).

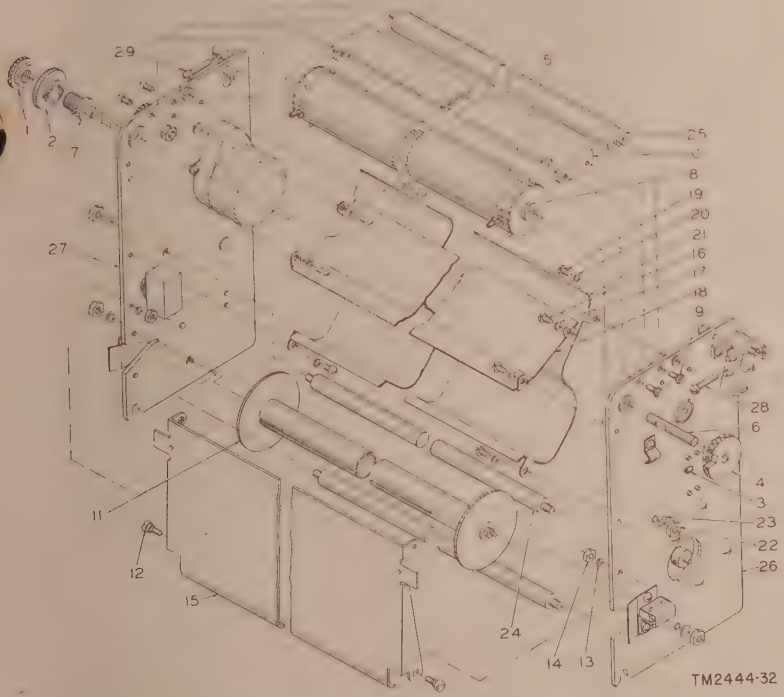
e. Lift out the takeup reel (11).

f. Unscrew the two shoulder screws (12), freeing the two nuts (14), lockwashers (13), and panel (15).

g. Remove the four screws (16) and lockwashers (17), freeing the bracket (18).

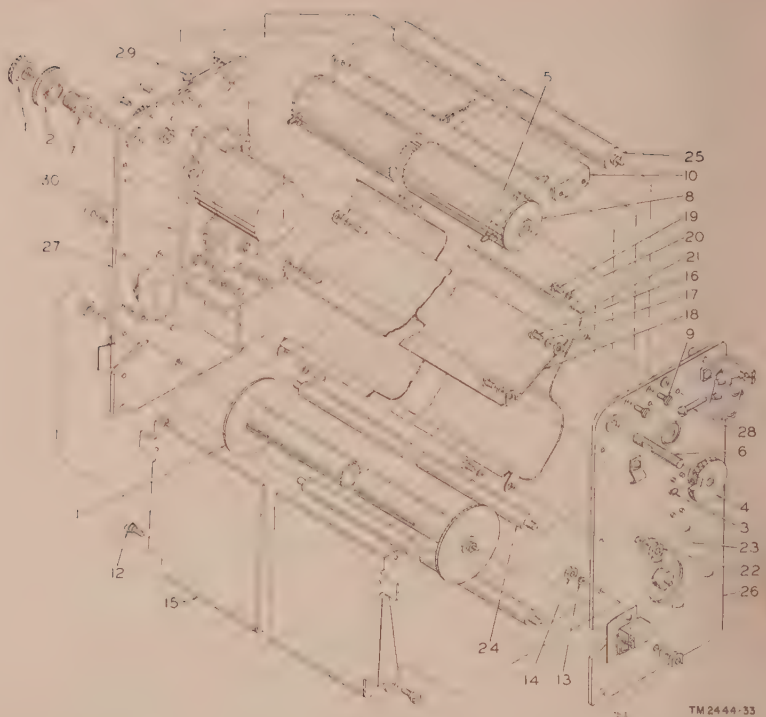
h. Remove the six screws (19) and lockwashers (20), freeing the shelf (21).

i. Remove the four nuts (22) and lockwashers (23), and remove the two braces (24). Separate the side plates (26 and 27), and free the idler roller (25).



1	Gear nut (O 411).	12	Shoulder screw (O 417).	23	Lockwasher (H457).
2	Gear (O 403).	13	Lockwasher (H463).	24	Brace (O 423).
3	Set screw (H408).	14	Nut (H461).	25	Idler roller (O 409).
4	Chart set knob (O 407)	15	Panel (A 407).	26	Right side plate (A 405).
5	Set screw (H404).	16	Screw (H442).	27	Left side plate (A 406).
6	Shaft (O 408).	17	Lockwasher (H435).	28	Right positioning screw (H483).
7	Shaft assembly (A 405).	18	Bracket (A 404).	29	Left positioning screw (H484).
8	Chart drive roll (O 406).	19	Screw (H415).		
9	Screw (H409).	20	Lockwasher (H413).		
10	Bracket (A 401).	21	Shelf (A 402).		
11	Takeup reel (A 410).	22	Nut (H453).		

Figure 32. Chart drive mechanism (RO–2/GMQ), exploded view.



1	Gear nut (O 411).	13	Lockwasher (H463).	25	Idler roller (O 409).
2	Gear (O 403).	14	Nut (H461).	26	Right side plate (A 405).
3	Set screw (H408).	15	Panel (A 407).	27	Left side plate (A 406).
4	Chart set knob (O 407).	16	Screw (H442).	28	Right positioning screw (H483).
5	Set screw (H404).	17	Lockwasher (H435).	29	Left positioning screw (H484).
6	Shaft (O 408).	18	Bracket (A 404).	30	Re tifier-transformer-bracket assembly and motor.
7	Shaft assembly (A 405).	19	Screw (H415).		
8	Chart drive roll (O 406).	20	Lockwasher (H413).		
9	Screw (H409).	21	Shelf (A 402).		
10	Bracket (A 401).	22	Nut (H453).		
11	Takeup reel (A 410).	23	Lockwasher (H457).		
12	Shoulder screw (O 417).	24	Brace (O 423).		

Figure 33. Chart drive mechanism (RO–2A/GMQ), exploded view.

j. Remove the positioning screws (28 and 29).

k. Remove the black leads from terminal board (20, fig. 37), allowing the side plates (26 and 27) to be separated completely.

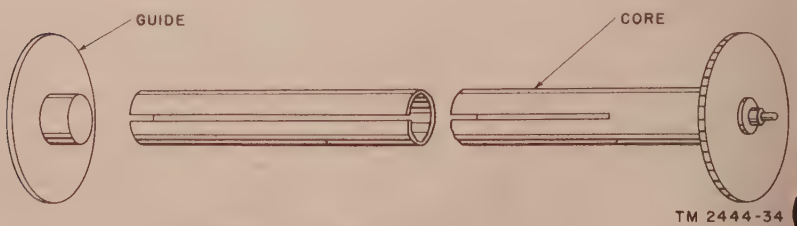


Figure 34. Takeup reel, exploded view.

64. Disassembly of the Takeup Reel
(fig. 34)

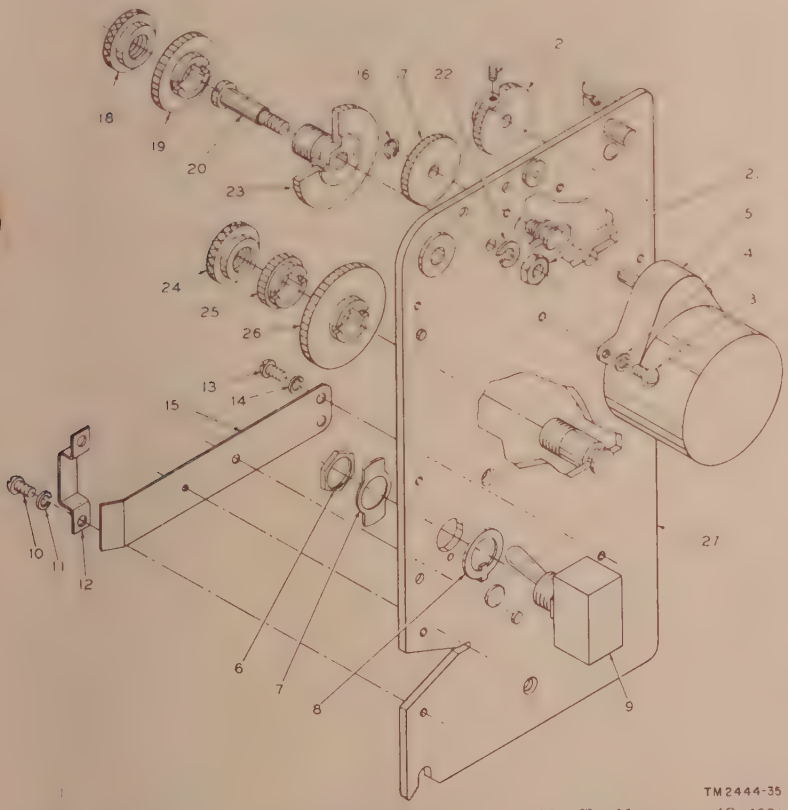
Pull the guide from the core. No further disassembly is required. Be sure that the core is not buckled or bent in disassembly.

65. Disassembly of Left Plate Assembly (RO–2/GMQ)
(fig. 35)

To disassemble the left plate assembly, proceed as follows:

a. Unscrew the set screw (1), and remove the gear (2).

b. Unscrew the two screws (3), freeing the lockwashers (4) and chart drive motor (5).



1	Set screw (H417).	10	Screw (H465).	20	Shoulder screw (O 402).
2	Gear (O 410).	11	Lockwasher (H467).	21	Nut (H403).
3	Screw (H419).	12	Bracket (A 409).	22	Lockwasher (H402).
4	Lockwasher (H421).	13	Screw (H449).	23	Gear assembly (O 413).
5	Chart drive motor (B401).	14	Lockwasher (H451).	24	Nut (O 415).
6	Locknut (part of S402).	15	Spring catch (A 408).	25	Gear (O 414).
7	Marker (part of S402).	16	Retaining ring (H401).	26	Gear (O 416).
8	Locking ring (H469).	17	Idler gear (O 401).	27	Plate (A 406).
9	Switch (S402)	18	Nut (O 412).		
		19	Gear (O 404).		

Figure 35. Left plate assembly, (RO–2/GMQ), exploded view.

c. Tag each terminal on the switch (9) with the wire number of the attached wire. Unsolder the wires. Unscrew the lock nut (6), freeing the marker (7) locking ring (8), and switch (9).

d. Unscrew the two screws (10), freeing the lockwashers (11) and bracket (12).

e. Unscrew the two screws (13), freeing the lockwashers (14) and spring catch (15).

f. Remove the retaining ring (16) and remove the idler gear (17).

g. Unscrew the shoulder screw (20), freeing the gear (23), lockwasher (22), and nut (21).

h. Unscrew the nut (24), and remove the gears (25 and 26) from the side plate (27).

66. Disassembly of Left Plate Assembly (RO–2A/GMQ) (fig. 36)

To disassemble the left plate assembly proceed as follows:

a. Unscrew the nut (18) and remove the gear (19).

b. Unscrew the two set screws (1) and remove the gear (2).

c. Unscrew the two screws (3) and free the lockwasher (4). Unscrew the two screws (28) and free the lockwasher (29). Remove the rectifier-transformer-bracket assembly and the motor (30, fig. 33).

d. Unsolder the wires from the transformer (37, fig. 36) and rectifier (33).

e. Unscrew the screw (31), and free the nut (32), rectifier (33), and spacing washer (34).

f. Remove the two screws (35) and free the lockwasher (36) and the transformer (37).

g. Unscrew the two screws (10) and free the lockwashers (11) and bracket (12).

h. Unscrew the two screws (13) and free the lockwasher (14) and spring catch (15).

i. Remove the retaining ring (16) and remove the idler gear (17).

j. Remove the shoulder screw (20) and free the gear (23), lockwasher (22), and nut (21).

k. Unscrew the nut (24) and remove the gears (25 and 26) from the side plate (27).

l. Unscrew the nut (6) and remove switch (9) and free ring (8) and plate (7). Tag each terminal on the switch (9) with the wire number of the attached wires. Unsolder the wires.

67. Disassembly of Right Plate Assembly (fig. 37)

To disassemble the right plate assembly, proceed as follows:

a. Remove the set screw (1) and pull off the gear (2).

b. Unsolder the wires from the takeup motor (6). Unscrew the four

screws (3), freeing the lockwashers (4), spacers (5), and the takeup motor (6).

c. Tag each terminal on switch (11) with the wire number of the attached wire. Unsolder the wires. Unscrew the two screws (8), freeing the nuts (7), two lockwashers (9), switch (11), and switch guard (10).

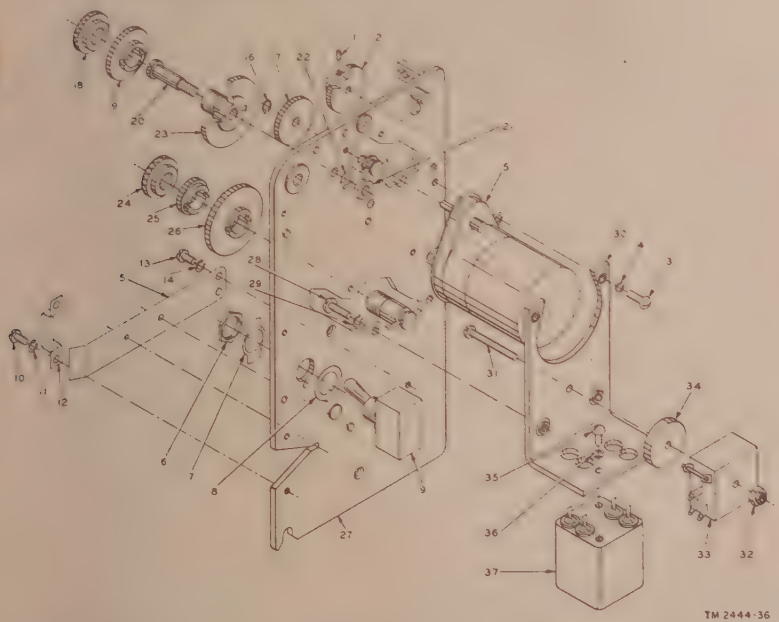
d. Remove the two screws (12), freeing the lockwashers (13) and the switch bracket (14).

e. Unscrew the screw (15), freeing the lockwasher (16) and retainer (17).

f. Tag each terminal of the terminal board (20) with the number of the attached wire. Remove the wires. Remove the four screws (18), lockwashers (19), and terminal board (20).

g. Unscrew the screw (21), freeing the lockwasher (22) and clamp (23).

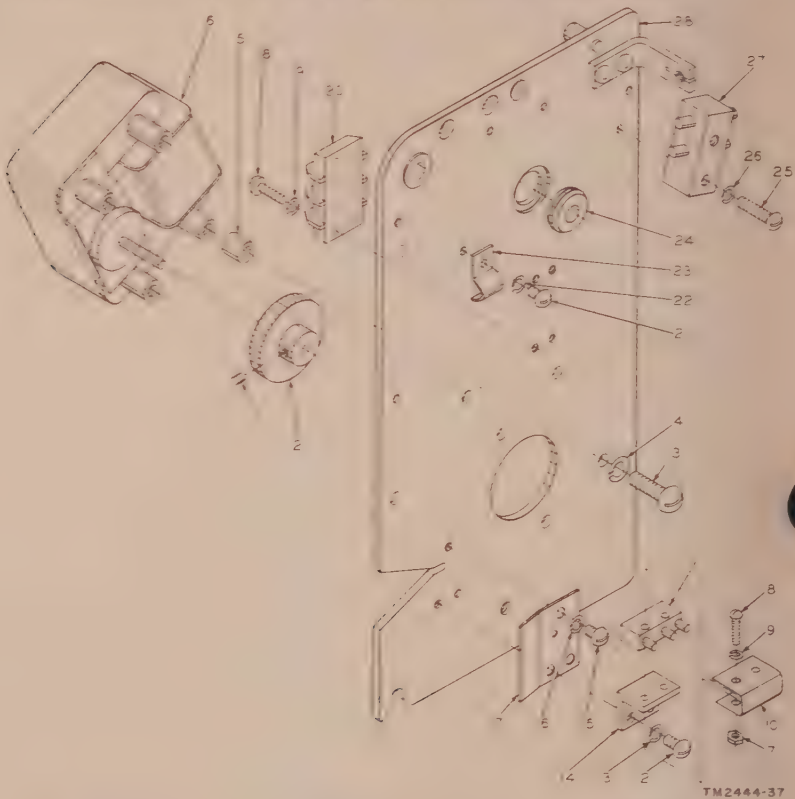
h. Pull out the grommet (24).



1	Set screw (H417).	13	Screw (H449).	26	Gear (O 416).
2	Gear (O 410).	14	Lockwasher (H451).	27	Plate (A 406).
3	Screw (H419).	15	Spring catch (A 408).	28	Screw (H1741).
4	Lockwasher (H421).	16	Retaining ring (H401).	29	Lockwasher (H1739).
5	Chart drive motor (B401).	17	Idler gear (O 401).	30	Bracket (A 485).
6	Locknut (part of S402).	18	Nut (O 412).	31	Screw (H1734).
7	Marker (part of S402).	19	Gear (O 404).	32	Nut (H1733).
8	Locking ring (H469).	20	Shoulder screw (O 402).	33	Rectifier (CR401).
9	Switch (S402).	21	Nut (H403).	23	Washer (O 459).
10	Screw (H465).	22	Lockwasher (H402).	35	Screw (H1735).
11	Lockwasher (H467).	23	Gear assembly (O 413).	36	Lockwasher (H1737).
12	Bracket (A 409).	24	Nut (O 415).	37	Transformer (T401).
		25	Gear (O 414).		

Figure 36. Left plate assembly (RO–2A/GMQ), exploded view.

i. Unsolder the wires from the plug (27). Remove the two screws (25), lockwashers (26), and plug (27) from the plate (28).



1	Set screw (H497).	11	Microswitch (S403).	21	Screw (H443).
2	Gear (O 425).	12	Screw (H480).	22	Lockwasher (H444).
3	Screw (H489).	13	Lockwasher (H478).	23	Clamp (E401).
4	Lockwasher (H493).	14	Switch bracket (A 414).	24	Grommet (A 403).
5	Spacer (O 419).	15	Screw (H470).	25	Screw (H485).
6	Takeup motor (B402).	16	Lockwasher (H471).	26	Lockwasher (H487).
7	Nut (H474).	17	Retainer (A 413).	27	Plug (P401).
8	Screw (H476).	18	Screw (H427).	28	Plate (A 405).
9	Lockwasher (H472).	19	Lockwasher (H423).		
10	Switch guard (E402).	20	Terminal board (TB403).		

Figure 37. Right plate assembly, exploded view.

68. Replacement or Repair of Damaged or Worn Parts

Straighten or repair parts that are dented or have other minor defects. Replace worn sliprings, brushes, bearings, and threaded parts. If the sliprings need to be replaced, replace the entire assembly (52, fig. 28).

69. Cleaning

Follow the procedures in *a* and *b* below when performing field maintenance on the equipment.

a. Cleaning Electrical Parts.

(1) Wipe dirty or oily slip rings, brushes, and contacts with a clean, lint-free cloth.

(2) Use very fine sandpaper No. 6/0 to eliminate pitting or corrosion.

(3) Replace parts which the above methods fail to restore.

Caution: Do not use a solvent on electrical parts.

b. Cleaning Mechanical Parts. Clean mechanical parts, other than painted surfaces and the window, with solvent SD; use a stiff brush. Wipe with a clean lint-free cloth all surfaces cleaned with solvent. Wash painted surfaces and window with soap and water and then dry thoroughly.

Caution: Do not clean the window with a solvent as fine cracks and clouding may result.

70. Testing Components and Assemblies

Most of the testing is done after the recorder has been reassembled; however, electrical continuity circuit checks of all assemblies and components should be made before reassembly. Paragraph 71 lists the components to be given a resistance test. The resistance from any terminal to ground should be greater than 200,000 ohms. Use Multimeter TS-352/U for the continuity checks.

71. Resistance Checks

The following chart lists various components that should be checked before reassembling these components to the equipment:

Name	Check point	Fig. No.	Fig. ref No.	Resistance (ohms)
Resistor R405	Resistor terminals	22		2,235 ±6
Voltmeter M402	Movement leads	22		65 ±1
Voltmeter M401	Assembly leads	22		2,300 ±11.5
Thermal-delay relay K403	Terminals 2 and 3	28	1	3,500
Thermal-delay relay K403	Terminals 5 and 7	28	1	0
Coil L401	Terminals	28	26	63
Coil L402	Terminals	28	32	63
Synchro B403	Terminals	28	43	See note.
Relay K402	Coil terminals	28	68	3,000
Relay K401	Coil terminals	28	71	3,000
Resistor R403	Resistor terminals	31	40	2,300 ±11.5
Resistor R401	Resistor terminals	31	49	2,300 ±11.5
Resistor R402	Resistor terminals	31	50	1,533.3 ±7.6
Motor, chart drive B401 (RO-2/GMQ).	Leads	35	5	550
Motor, takeup B402	Terminals	37	6	30
Motor, chart drive B401 (RO-2A/GMQ).	Leads	39		20
Transfomer T401 (RO-2A/GMJ).	Terminals 1 and 2	39		900
	Terminals 3 and 4	39		7.8

Note. All individual components should be checked before being electrically connected to avoid shunted readings. The resistance across any two leads S1, S2, and S3 should be the same as the resistance across any other two leads in the same group. A resistance check should show continuity across R1 and R2. No exact resistance values for individual synchros are given since these values are variable depending on the manufacturer. Therefore, the resistance values of the indicator and transmitter synchros may be different even though both synchros are in satisfactory condition.

72. Lubrication

To lubricate the equipment at field maintenance level, proceed as follows:

a. Clean disassembled parts with solvent (SD) to remove all dirt, old oil, or other foreign matter.

b. Dry before lubricating.

c. Lubricate according to the instructions in paragraph 26.

d. Remove all excess lubricant.

e. Inspect electrical parts after lubricating the equipment.

f. Remove any lubricant from electrical parts by wiping thoroughly with a dry, lint-free cloth.

73. Reassembly

a. General. Reassembly is the reverse of disassembly. Certain adjustments and preparations must be made before the recorder is ready for operation. The instructions for making these adjustments and preparations are outlined in *b* through *n* below. Figures 38 and 39 are electromechanical schematic diagrams that will aid in making continuity checks.

b. Reassembly of Right Plate Assembly (fig. 37).

(1) Replace the screws (25), lockwashers (26), and plug (27). Solder wires number 2–6 and 2–4 to the plug (27).

(2) Replace the grommet (24).

(3) Replace the screw (21) that secures the lockwasher (22) and clamp (23).

(4) Replace the screws (18), lockwashers (19), and terminal board (20). Replace the wires on the terminal board (20), matching the tag numbers with wire numbers.

(5) Replace the screw (15) that secures the lockwasher (16) and retainer (17).

(6) Replace the screws (12) that secure the lockwashers (13) and switch bracket (14).

(7) Replace the screws (8) that secure the nuts (7), lockwashers (9), switch (11), and the switch guard (10). Solder the wires to the switch (11), matching tag numbers with wire numbers.

(8) Replace the screws (3) that secure the lockwashers (4), spacers

(5), and takeup motor (6). Solder wires 2–1 and 2–3 to the takeup motor (6).

(9) Replace the set screw (1) and gear (2).

c. Reassembly of Left Plate Assembly (RO-2 GMQ) (fig. 35).

(1) Replace the nut (24) and gears (25 and 26) to the side plate (27).

(2) Replace the shoulder screw (20) that secures the gear (23), lockwasher (22), and nut (21).

(3) Replace the retaining ring (16) and idler gear (17).

(4) Replace the screws (13), lockwashers (14), and spring catch (15).

(5) Replace the screws (10), lockwashers (11), and bracket (12).

(6) Replace the locknut (6), marker (7), locking ring (8), and switch (9). Solder the wires to the switch (9), matching tag numbers with wire numbers.

(7) Replace the screws (3), lockwashers (4), and chart drive motor (5). Connect the chart drive motor (5) after the chart drive mechanism is reassembled (*e* below).

(8) Replace the set screw (1) and gear (2).

d. Reassembly of Left Plate Assembly (RO-2A GMQ) (fig. 36).

(1) Replace the nut (24) and gears (25 and 26) to the side plate (27).

(2) Replace the shoulder screw (20) and secures the gear (23), lockwasher (22), and nut (21).

(3) Replace the idler gear (17) and secure it with the retaining ring (16).

(4) Attach the spring catch (15) to the side plate (27) with the two screws (13) and lockwashers (14).

(5) Attach the bracket (12) with the screws (10) and lockwashers (11).

(6) Replace the locknut (6), marker (7), locking ring (8) and switch (9). Solder the wires to the switch (9); match the tag numbers with the wire numbers.

(7) Attach the transformer (37) to the bracket (30); use lockwashers (36) and screws (35).

(8) Attach the spacer (34) and rectifier (33) to the bracket (30) with the screw (31) and nut (32).

(9) Solder the wires to the terminals of the transformer and rectifier in accordance with figure 39.

(10) Attach the motor (5) and the transformer-rectifier-bracket assembly to the side plate (27) with the screws (3 and 28) and lockwashers (4 and 29).

(11) Replace the gear (2) and secure it with set screws (1).

(12) Replace the gear (19) and secure it with nut (18).

e. Reassembly of Takeup Reel (fig. 34). Replace the guide (1) in

the core (2). No further reassembly is required. Be sure that the core is not buckled or bent in reassembly.

f. Reassembly of Chart Drive Mechanism (fig. 32).

(1) Replace the positioning screws (28 and 29).

(2) Replace the nuts (22), lockwashers (23), and braces (24). Replace the side plates (26 and 27) that secure the idler roll (25).

(3) Replace the screws (19) and lockwashers (20) that secure the shelf (21).

(4) Replace the screws (16) and lockwashers (17) that secure the bracket (18).

(5) Replace the shoulder screws (12) that secure the nuts (14), lockwashers (13), and panel (15).

(6) Replace the takeup reel (11).

(7) Replace the screws (9) that secure the bracket (10).

(8) Replace the set screw (5) and shafts (6 and 7) that secure the drive roll (8).

(9) Replace the set screws (3) and set knob (4).

(10) Replace the nut (1) and gear (2).

(11) Replace wire from chart drive motor (5, fig. 33) on the terminal board (20, fig. 37).

g. Reassembly of Case Assembly (fig. 31).

(1) Replace the nuts (81) that secure the lockwashers (82). Replace the mounting studs (83) in the case (84).

(2) Replace the screws (78) that secure the lockwashers (79) and mounting feet (80).

(3) Replace the locknut (73) that secures the washer (74), identification plate (75), locking ring (76), and switch (77). Solder the wires to the switch (77), matching tag numbers with wire numbers.

(4) Replace the locknut (68) that secures the washer (69), identification plate (70), locking ring (71), and switch (72). Solder the wires to the switch (72), matching tag numbers with wire numbers.

(5) Replace the screws (62) that secure the lockwashers (63) and jack (64). Replace the screws (65) that secure the lockwashers (66) and bracket (67). Solder wire number 1–9 and 1–11 to jack (64).

(6) Replace the fuses (59). Replace the screws (58) that secure the lockwashers (60) and fuse mounting (61). Solder the wires to the fuse mounting (61) matching tag numbers with wire numbers.

(7) Replace the screws (54) that secure the lockwashers (55), terminal board (56), and terminal marker (57). Place the wire on the terminal board (56) as follows: wire number 1–33, 1–8,

1–10, and 1–11 on terminal R1; wire number 1–7, 1–9, 1–13, and 1–21 on terminal R2; wire number 1–19 on V1; wire number 1–20 on V2; wire number 1–3 on V3; and wires number 1–1, 1–14, and 1–10 on L1.

(8) Replace the screws (51), freeing the lockwashers (52) and mounting plate (53).

(9) Replace the screw (46) that secures the lockwasher (47), nut (48), and resistors (49 and 50). Solder the wires to the resistor (49) as follows: Solder wires number 1–15 and 1–20 to one side and wire number 1–16 to the other. Solder the wires to the resistor (50) as follows: Solder wires number 1–17 and 1–19 to one side and wire 1–18 to the other side.

(10) Replace the screws (43) that secure the lockwashers (44) and mounting plate (45).

(11) Replace the screw (37) that secures the lockwasher (38), nut (39), and resistor assembly (40). Solder the terminals (42) to the resistor (41). Connect resistor (41) as directed in paragraph 13.

(12) Replace the screws (33) that secure the lockwashers (34), protective cover (35), and spacers (36).

(13) Replace the screws (25) and lockwashers (26) that secure the receptacle mounting plate (32). Replace the screws (27) that secure the lock washers (28), nuts (29), and receptacles (30 and 31). Solder wires number 1–24 and 1–34 to the receptacle (30). Solder the wires to the receptacle (31) as follows: Wire number 1–3 to pin A; wire number 1–21 to pin B; wire number 1–6 to pin C; wire number 1–5 to pin D; wire number 1–4 to pin E; wire number 1–17 to pin F; wire number 1–22 to pin G; wire number 1–26 to pin H.

(14) Replace the screws (17) that secure the lockwashers (18) and right hand bracket (24). Replace the nut (19), washers (20 and 21), nut (22), and pivot stud (23).

(15) Replace the screws (9) that secure the lockwashers (10) and left hand bracket (16). Replace the nut (11), washers (12 and 13), nut (14), and pivot stud (15).

(16) Replace the screws (1) that secure the lockwashers (2) and bracket (8). Replace the shoulder screw (4) that secures the nut (5), lockwashers (6), and latch (7). Replaces the spring (3) on the latch (7).

h. Reassembly of Chart Guide-Pen Lift Mechanism (fig. 30).

(1) Replace the screws (21) and lock washers (22) that secure the right and left chart guides (23 and 24).

(2) Replace the pivot studs (16), spring washers (17), spacers (18), lockwashers (19), and nuts (20) that secure the lever

assembly (25) to the right and left bracket assemblies (27 and 26).

(3) Replace the two screws (9), lockwashers (10), washers (11), latches (12), springs (13), spacers (14), and nuts (15).

(4) Replace the direction and speed scales (6 and 7) on the scale holder (8) by replacing the screws (4) and lockwashers (5).

(5) Replace the shoulder screws (1) that secure the nuts (2), lockwashers (3), and scale holder (8).

i. Reassembly of Wind Speed Unit Assembly (fig. 29).

(1) Replace the screws (6) and lockwashers (7), and replace the bracket (8) to the voltmeter (9).

(2) Replace the screw (2), lockwasher (3), and collar (4) to the shaft (5).

(3) Replace the ink tank (1).

j. Reassembly of Direction Mechanism (fig. 28).

(1) Replace the dowel pins (73) in the housing (74).

(2) Replace the screws (46) that secure the lockwashers (47) and top movement assembly (51).

(3) Replace the screws (53) that secure the lockwashers (54), nuts (55), and contact arms (56 and 57) to the sector assembly (58).

(4) Replace the screw (48) that secures the lockwasher (49) and tightens the clamping block (50) so that the contact arms (56 and 57) will sit parallel to the direction pen when it is seated in the pen holder on top of the upper movement assembly (51). Replace the wire between the contact arm and terminal extending from the rear of the slipring.

(5) Replace the nuts (66 and 69) that secure the lockwashers (67 and 70) and relays (68 and 71). Solder the wires to the relays (68 and 71,), matching tag numbers with wire numbers.

(6) Replace the screws (59) that secure the spacers (61) and the contact plate assembly (63). Solder the wires to the terminals on the contact plate assembly (63), matching tag numbers with wire numbers.

(7) Replace the contact screws (62 and 61).

(8) Replace the screws (64) that secure the lockwasher (65) and bracket (72).

(9) Replace the ink tank (45) in the top movement assembly (51).

(10) Replace the screws (40) that secure the lockwashers (41), washers (42), and the synchro (43) in the housing (44).

(11) Replace the nut (37) that secures the lockwasher (38) and the pinion and disk assembly (39).

(12) Replace the screws (34) that secure the lockwashers (35), washers (36), and the synchro housing assembly (44). Replace the wires on the synchro (43) as follows: Wire number

3-9 on R2; wire number 3-8 on S1; wire number 3-7 on S2; and wire number 3–6 on S3.

(13) Replace the screws (22 and 28) that secure the lockwashers (23 and 29), spacers (24 and 30), cores (27 and 33), coils (26 and 32), and brackets (25 and 31).

(14) Replace the screw (17 and screws (19) that secure the lockwashers (18 and 20) and bracket (21).

(15) Replace the screws (13) that secure the lockwashers (14), terminal board (15), and terminal marker (16). Replace the wires on the right side of the terminal board (15) as follows: wire number 3-5 to terminal R1C; wire number 3-6 to S3; wire number 3-7 to S2; wire number 3-8 to S1; wires number 3–9 and 3-10 to R2; and wires number 3-11 and 3-12 to R1.

(16) Replace the screws (9) that secure the lockwashers (10) and motor coil (11). Solder wires number 3–3 and 3–15 to the coil (11).

(17) Replace the screws (7) that secure the lockwashers (8), bracket (75), and motor coil (12). Solder wires number 3-21 and 3–26 to the coil (12).

(18) Replace the screws (2) that secure the lockwashers (3), socket (4), retainer (5), and nuts (6). Solder the wires to the socket (4) as follows: Solder wire number 3-2 to pin 2; wire number 3–1 to pin 3; wires number 3-3 and 3-26 to pin 5; wires number 3–4 and 3–2 to pin 7.

(19) Plug in the relay (1) and clip on the retainer (5).

k. Replacing Glass Writing Pen. The glass writing pen is replaceable at organizational level. When the equipment has been disassembled at field maintenance level, and a replacement of the pen is necessary, refer to paragraph 24*c*(4).

l. Replacement of Major Components (fig. 27).

(1) Replace the screw (26) that secures the lockwashers (28), nut (27), and speed mechanism assembly (29) in the case assembly (30).

(2) Replace the red wire of the speed mechanism assembly (29) on terminal V1 of the terminal board (56, fig. 31). Replace the black wire on terminal V2. Replace the screws (33, fig. 31) that secure the lockwashers (34), protective cover (35), and spacers (36).

(3) Replace the screws (24) that secure the lockwashers (25).

(4) Replace the lever (23).

(5) Replace the screws (20) that secure the lockwashers (21) and adjustment scale plate (22).

(6) Replace the thumbscrew (19).

(7) Replace the screws (16) that secure the lockwashers (17) and

the direction mechanism assembly (18). Replace the wire on the left side of the terminal board (15, fig. 28) as follows: Wire number 1–3 to terminal R1C; wire number 1–4 to S3; wire number 1–5 to S2; wire number 1–6 to S1; wire number 1–7 to R2; and wire number 1–8 to R1.

(8) Replace the screw (12) that secures the lockwasher (13), nut (14), and lever assembly (15).

(9) Replace the screws (9) that secure the lockwashers (10) and adjustment scale plate (11).

(10) Replace the thumbscrew (8).

(11) Replace the direction pen (5) and speed pen (6). If necessary, replace the pen point (7) (*j* above).

(12) Replace the screws (1) that secure the nuts (2), lockwashers (3), and the chart guide-pen lift mechanism (4). Solder wires number 1–1 and 1–2 to socket of lamp I 401 and wires number 1–14 and 1–27 to socket of lamp I 402 (figs. 38 and 39).

m. Reassembly of Door Assembly (fig. 26).

(1) Replace the door gasket (19).

(2) Replace the screws (10) and lockwashers (11) that secure the retainers (12 and 13), shields (14 and 15), window (16), and gaskets (17 and 18) in the door frame (20).

(3) Replace the screws (8), and replace the caution notice plate (9).

(4) Replace the screws (5) and lockwashers (6), and replace the name plate (7).

(5) Replace the set screws (1) that secure the latch (2), washer (3), and handle (4).

n. Replacement of Door and Cables (fig. 25).

(1) To reassemble the power cable (1), loosen the clamp on the plug (12) and solder the cable (11). Remove the cable clamp (10) and solder the wires to the plug (9). Replace the cable clamps.

(2) Screw the set screws (4) that secure the hinge pins (5), washers (6), and door assembly (7) to the case (8).

(3) Replace the cable clamp (3) to the connector (2).

(4) Replace the power cable (1) and connector (2).

74. Refinishing

Complete instructions for repainting Signal Corps equipment are found in TM 9-2851, Painting Instructions for Field Use. Fungiproofing will be accomplished in accordance with instruction in TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment.

Note. Do not use steel wool. Minute particles frequently enter the case, voltmeter, or cable connectors and cause harmful shorting or grounding of circuits.

Section IV. ALINEMENT PROCEDURES

75. Final Adjustments

a. Positioning Chart Drive Mechanism. This unit is positioned correctly when the pens follow the time lines of the chart, both pens indicate the same time, and the mechanism locks securely in its operating position. To position the mechanism correctly, proceed as follows:

(1) Use the adjusting nuts (11, 14, 22, and 19, fig. 31), to move the chart drive mechanism across the front of the recorder until the pens follow the time line of the chart with a minimum of error.

(2) By moving one of the pivot studs (23 or 15) in the slot of the bracket (24 or 16) toward the front or rear of the recorder and the other stud in the opposite direction, the pens can be made to indicate the same time.

(3) After setting for time, see whether the pens still follow the time lines. If they do not, again move the mechanism across the front of the recorder and repeat the procedure. The backlash between the mechanism and pivots should be .005 to .010 inch.

(4) By adjusting the two screws (28 and 29, fig. 32) in the ears protruding from the top rear of the chart drive mechanism, the unit can be adjusted so that it will lock in position properly.

b. Setting Chart Guides (fig. 30). The two chart guides (23 and 24) should be set so that there is clearance ($\frac{1}{32}$-in. max.) between the chart and the guides. The clearance is obtained by adjusting the two set screws. If the guides are distorted, reshape them by hand and make final settings with the aid of the set screws.

c. Setting Direction and Speed Scales. Set the direction and speed scales (6 and 7, fig. 30) so that they are in agreement with the chart indications by loosening the four screws (4) and moving the scales across the scale bracket until they are alined.

d. Balancing Pen. The pen elements are balanced properly when they are full of ink and the balance adjustment should not be changed unless necessary. The pen balance should be such that when the chart is tapped lightly with one finger, the pen will bounce up and down on the chart. A pen pressure that is too heavy on the chart will cause the pen to drag toward the center of the chart or will noticeably reduce the speed of response of the pen. Accordingly, if maximum response speed is desired, the pen pressure must be not greater than is necessary for satisfactory inking. Handle the pen element carefully; a bent element will cause incorrect readings.

e. Setting Direction Unit. The direction unit is set correctly if the pen indicates 360° on the chart when the recorder is wired as shown in

figure 22. To make the necessary setting, proceed as follows:

(1) Connect as shown in figure 22.

(2) Apply power.

Caution: Do not allow the 115-volt, ac power to be connected for more than 30 seconds; serious damage may result due to overheating the synchro.

(3) Upon applying 115-volt, ac power, the pen should move to the 360° position of the chart. Tap the mechanism to remove residual friction. Small positioning errors may be corrected by loosening the thumbscrew (8, fig. 27) and moving the arm. If the error is large, loosen the screw (12) that clamps the lever on the synchro and position the synchro so that the pen is on the 360° line and zero setting is centered. Make small corrections by using the lever.

f. Setting Direction Pen Reversal Contacts (fig. 28). The setting of these contacts will not alter the accuracy with which the pen follows the position of the synchro. The relationship of pen to synchro is a fixed relationship brought about by the meshing of gears. Arbitrary settings have been selected where the pen will reverse 10 wind degrees from each end of the scale. To make these settings, energize the recorder, disconnect plug P403 (the eight-conductor cable plug), manually move the pen, and adjust the two screw contacts (61 and 62) until the desired settings are obtained.

g. Direction Pen Alinement. Install the direction pen. Check to see that the pen arm sits parallel to the moving contacts (56 and 57, fig. 28) on the contact and sector assembly (52). If not, loosen the screw (48), and rotate the pen holder until the pen arm is alined. Electrical alinement is described in *e* above.

h. Zeroing Speed Mechanism (fig. 21). Move the adjusting lever until the pen indicates zero on the chart. Tap the mechanism to remove residual friction.

76. Final Tests

After the equipment has been completely reassembled and after performing the procedures outlined in paragraph 68, the equipment should be operated according to instructions in paragraph 20. If the equipment fails to perform satisfactorily, refer to the troubleshooting procedure (par. 54).

CHAPTER 7

SHIPMENT AND STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND STORAGE

77. Disassembly and Preliminary Packaging

a. Remove the chart drive mechanism, illuminating lamps, pens, ink tanks, and cables from the recorder.

b. Wash the ink tanks and pens; be sure that all ink is removed. Rinse and dry thoroughly (par. 24*c*).

c. Remove the chart from the chart drive mechanism.

d. Secure the movable parts inside the recorder case as follows:

(1) Secure approximately ½-inch wide tape to the direction unit pen adjustment scale and tie the other end to the left operation lever (fig. 9) so that it is held firmly and is not free to move upward or downward.

(2) Secure tape to the speed unit pen adjustment scale and tie the other end to the right operation lever (fig. 9) so that it is held firmly.

(3) Push the scale holder assembly (8, fig. 30) upward and backward to its extreme upward position. Tie tape to the center of the scale and secure it to the lever bracket (25) in the rear of the chart guide-pen lift mechanism.

(4) Secure tape to the retaining latch (7, fig. 31) in the lower left side of the case and wrap it around the latch bracket assembly (8).

e. Close the recorder case door and secure the latch.

f. Place a ⅜-inch steel strap around the case to secure the door and protect the plastic window. Prevent marring the case finish by placing single face corrugated fiberboard under the steel strap.

g. Wrap the recorder case and the chart drive mechanism separately in heavy paper.

h. Place each pen in a cardboard box and suspend it in a cardboard former so that it is held rigid. The box used for packing new equipment or one of similar characteristics is recommended.

i. Wrap each ink tank in tissue paper and place it in a close fitting

cardboard box. Coil the power cable so that its maximum length does not exceed the length of the pen boxes. Tie the coils with tape or ribbon.

j. Wrap each illuminating lamp in tissue paper and wrap both lamps in several layers of single face corrugated fiberboard to protect them against breakage.

k. Unsolder the cable from eight-contact connector P403 and package the connector in the same manner as the ink tanks. The eight-conductor cable is not normally shipped or stored with the recorder.

78. Repacking Domestic or Export

Pack the recorder and its related packages according to the packaging diagrams (figs. 3 and 4) and the following instructions:

a. Place the wrapped chart drive mechanism in a close fitting fiberboard carton and pad with corrugated fiberboard pads. Insert desiccant for export shipment.

b. Place the wrapped recorder case and the packaged chart drive mechanism in a close fitting fiberboard carton. Insert corrugated fiberboard pads. Insert desiccant for export shipment.

c. For export shipment, inclose the large fiberboard carton in a moisture-vaporproof barrier bag and insert the package in a second close fitting fiberboard carton.

d. Place the individually wrapped spares and accessories in a fiberboard carton (waterproof fiberboard carton for export shipment).

e. Place the technical literature in a waterproof envelope and seal.

f. Place the two fiberboard cartons and the envelope that contains the literature in a nailed wooden shipping container.

g. Nail the top in place and bind the container with steel straps.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

79. Destruction of Components

Follow the demolition procedures outlined in paragraph 80 to prevent the enemy from using or salvaging the equipment. Demolition of the equipment will be accomplished only upon order of the commanding officer.

80. Methods of Destruction

a. Smash. Smash the recorder and all component parts; use sledges, axes, handaxes, pickaxes, hammers, crowbars, or other heavy tools.

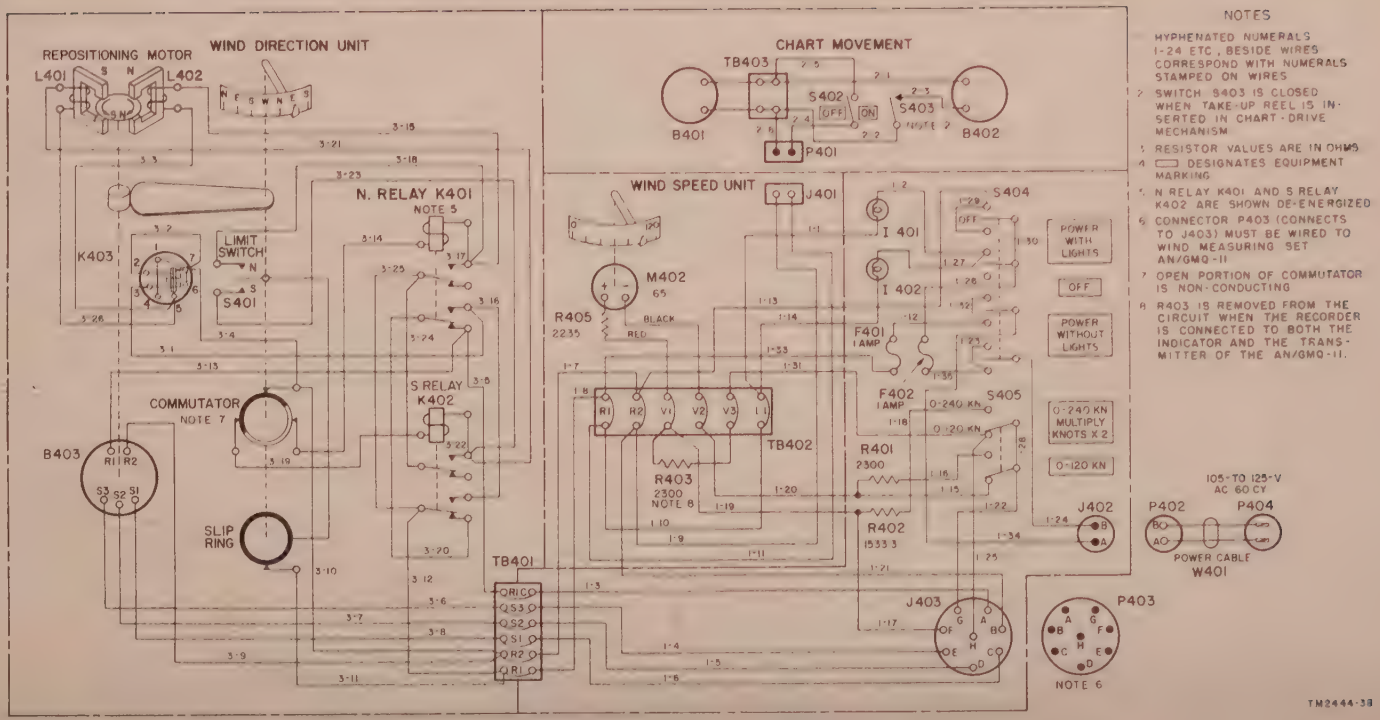
b. Cut. Cut all cables and connections; use axes, handaxes, or machetes.

c. Burn. Burn the charts and the technical manuals; use gasoline, kerosene, or oil.

d. Explosives. If explosives are necessary, use firearms, grenades or TNT.

e. Disposal. Bury or scatter the destroyed parts in slit trenches, fox holes, other holes, or throw them into streams.

f. Destroy. Destroy everything.



NOTES

HYPHENATED NUMERALS 1-24 ETC., BESIDE WIRES CORRESPOND WITH NUMERALS STAMPED ON WIRES

2 SWITCH S403 IS CLOSED WHEN TAKE-UP REEL IS INSERTED IN CHART-DRIVE MECHANISM

3 RESISTOR VALUES ARE IN OHMS

4 ▭ DESIGNATES EQUIPMENT MARKING

5 N RELAY K401 AND S RELAY K402 ARE SHOWN DE-ENERGIZED

6 CONNECTOR P403 (CONNECTS TO J403) MUST BE WIRED TO WIND MEASURING SET AN/GMQ-11

7 OPEN PORTION OF COMMUTATOR IS NON-CONDUCTING

8 R403 IS REMOVED FROM THE CIRCUIT WHEN THE RECORDER IS CONNECTED TO BOTH THE INDICATOR AND THE TRANSMITTER OF THE AN/GMQ-11.

Figure 38. Wind Direction and Speed Recorder RO 2/GMQ, electromechanical schematic diagram.

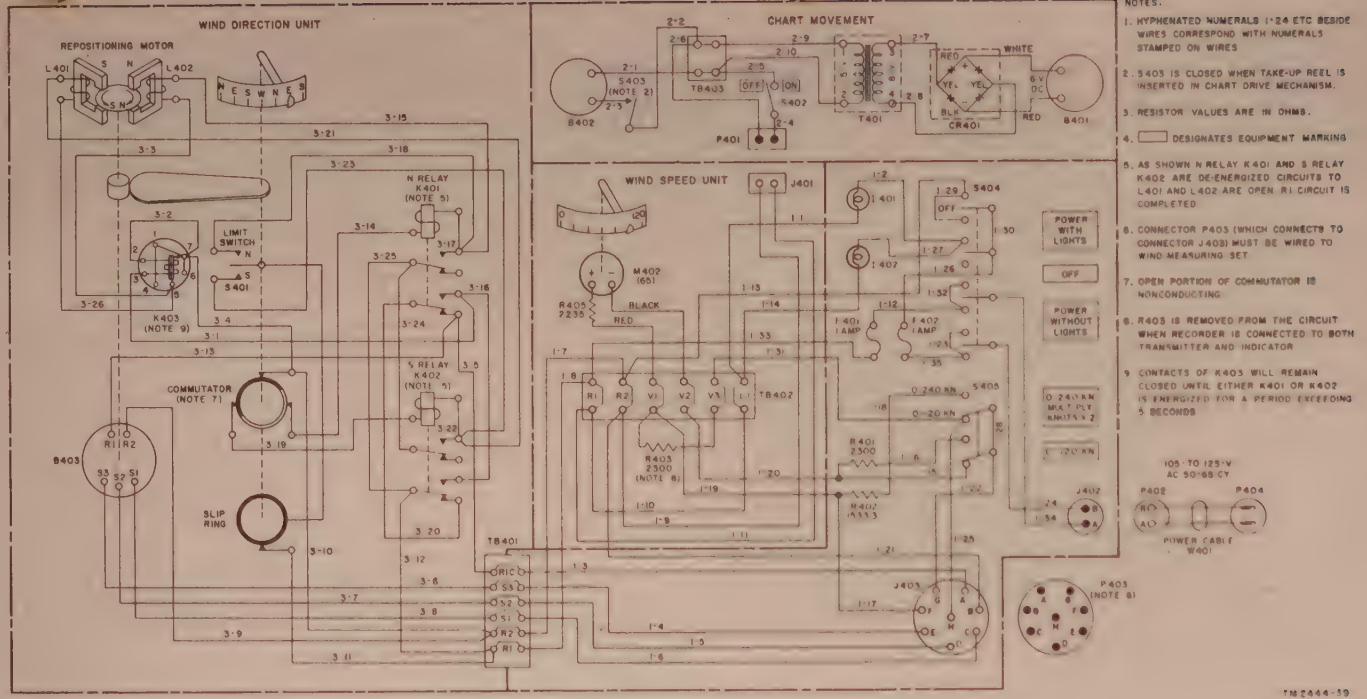


Figure 39. Wind Direction and Speed Recorder RO-7A GMQ, electromechanical schematic diagram.

INDEX

	Paragraphs	Page
Accessories	6	5
Accuracy of recorder	7	6
Additional equipment required	3*b*	4
Adjustment:		
Direction pen	34*a*	42
Final	75	83
Preliminary	17	19
Speed pen	34	42
AN/GMQ–11, Wind Measuring Set	3	3
Atmospheric conditions	7	6
Balancing pen	75*d*	
Cable. (*See* Connection.)		
Changing chart speed	17*a*	19
Chart:		
Description	5*a*(5)	5
Installation	17*c*	21
Time setting	18	24
Chart drive mechanism:		
Description	5*a*(3)	5
Installation	17*b*	20
Positioning	75*a*	83
Chart guide-pen lift mechanism, description	5*a*(4)	5
Chart movement switch	15	18
Chart speed, changing	17*a*	19
Chart, troubleshooting	54	55
Check:		
Operation	19	25
Resistance	71	75
Checklist, preventive maintenance	25	30
Checking for faults	49	50
Cleaning:		
Disassembled parts	69*a*, *b*	75
Field maintenance	51	54
Organizational maintenance	24*a*, *b*	29, 30
Common names	3*b*	4
Components	4	4
Destruction	80	86
Connections	13	13
Controls	15	18
Demolition	80	
Description	5	4

	Paragraphs	Page
Destruction of components	80	86
Detailed description of recorder	5	4
Difference in models	9	9
Direction mechanism, description	5*a*	4
Disassembly:		
Component	56–67	58
Field maintenance general	55	58
Shipment or storage	77	85
Dual range switch	15	18
Electrical supply	7	6
Equipment performance checklist	33	40
Field maintenance instructions	47–76	50
General	47	50
Tools and test equipment	48	50
Filling:		
Ink tanks	16	18
Pens	17*d*	20
Final tests	76	84
Forms and records	2*a*, *b*	3
[illegible] tank, filling	16	18
[illegible]ut signal	7	6
Inspecting:		
Field maintenance	49	50
Organizational maintenance	30	35
Installation	17	19
Levers, pen adjustment	15	18
Line voltage. (*See* Electrical supply.)		
Locating. (*See* Siting.)		
Lubrication	26	32
Measurements, range	7	6
Models, difference	9	9
Mounting. (*See* Installation.)		
Operation:		
Check	19	25
Normal	20	26
Unusual conditions	21	27
Organizational maintenance	22–34	29
Tools and materials	22	29
Packaging data	8	6
Shipment	77	85
Packing. (*See* Packaging.)		
Painting	30	35
Panel mounting	12*a*	11
Pen adjustment levers	15	18
Pens:		
Adjusting	34	42
Balancing	75*d*	83
Filling	17*a*	19

	Paragraphs	Page
Power and lights switch	15	18
Power, electrical	45	48
Preliminary adjustments	17	19
Preventive maintenance:		
Checklist	25	30
Definition	23	29
Techniques	24	29
Purpose and use	3	3
Range measurements	7	6
Range switch, dual	15	18
Reassembly	73	76
Reconditioned equipment, receipt	14	17
Recorder accuracy	7	6
Records, forms and	2	3
Refinishing	74	82
Repacking	78	86
Repairs:		
Field maintenance	68	74
Organizational maintenance	32*d*	39
Replacement, glass pen point	73*e*	77
Repositioning, theory	39	
Resistance check	71	
Running spares	6	
Setting	75	83
Signal input	7	6
Siting	11	10
Spares, running	6	5
Speed mechanism:		
Description	5*a*(2)	5
Theory	41	47
Stripping	50	53
Supply, electrical	7	6
Theory	45	48
Switch	15	18
Table mounting	12*b*	12
Takeup reel, installation	17*c*	21
Technical characteristics	7	6
Test equipment, field maintenance	48	50
Test, final	76	84
Theory:		
Chart drive mechanism	43	48
Electrical power	45	48
Wind direction	37	44
Wind speed	41	47
Time setting chart	18	24
Tools:		
Field maintenance	48	50
Organizational maintenance	22	29
Troubleshooting:		
Chart	54	
Procedures	53	

	Paragraphs	Page
Uncrating	10	10
Unpacking	10	10
Unusual conditions, operation	21	27
Used equipment, service on arrival	14	17
Weatherproofing	27	32
Wind Measuring Set AN/GMQ-11	3*b*	4

Wiring. (*See* Connections.)

Zeroing. (*See* Setting.)

[AG 413.6 (18 Apr 55)]

By order of the Secretary of the Army:

MAXWELL D. TAYLOR
General, United States Army,
Chief of Staff.

Official:

JOHN A. KLEIN,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

CNGB (1)
Tec Svc, DA (1)
Tec Svc Bd (1)
CONARC (5)
CONARC Bd (Incl ea Test Sec) (1)
Army AA Comd (2)
OS Maj Comd (5)
OS Base Comd (5)
Log Comd (5)
MDW (1)
Armies (5)
Corps (2)
Tng Div (2)
Ft & Cp (2)
Gen & Br Svc Sch (5)
SigC Sch (25)
Gen Depots (2)
SigC Sec, Gen Depots (10)
SigC Depots (20)
POE (2)
OS Sup Agencies (2)
SigC Fld Maint Shops (3)
SigC Lab (5)
Mil Dist (1)
Units organized under following TOE:
11–7, Sig Co Inf Div (2)
11–16A, Hq&Hq Co, Sig Bn, Corps or Abn Corps (2).
11–57, Armd Sig Co (2)
11–127, Sig Rep Co (2)
11–128A, Sig Depot Co (2)
11–500A (AA–AE), Sig Svc Org (2)
11–557A, Abn Sig Co (2)
11–587A, Sig Base Maint Co (2)
11–592A, Hq&Hq Co, Sig Base Depot (2)
11–597A, Sig Base Depot Co (2)

NG: State AG (6); Units—same as Active Army except allowance is one copy to each unit.

USAR: None.

For explanation of abbreviations used, see SR 320–50–1.

☆ U. S. GOVERNMENT PRINTING OFFICE:—55—345931